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SELECTED NEUTRAL SPECIES PROFILES, 0-100 KM.(U)
JUL 77 F E NILES, J M HEIMERL
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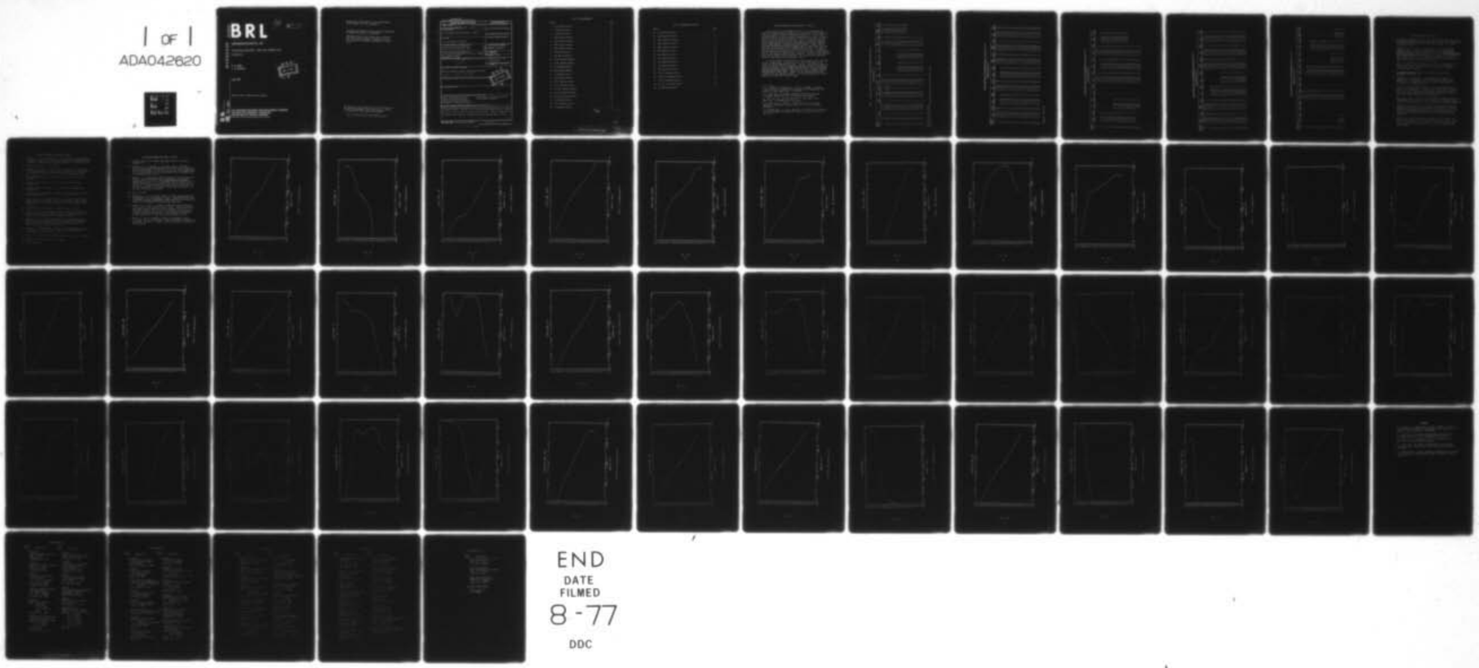

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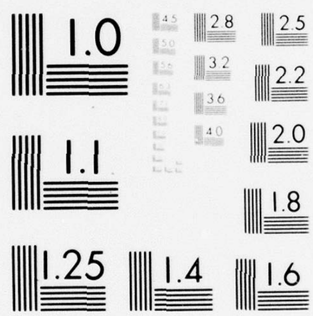
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MEMORANDUM REPORT NO. 2767

SELECTED NEUTRAL SPECIES PROFILES, 0-100 km

F. E. Niles
J. M. Heimerl

July 1977

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USA ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
USA BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

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Neutral density profiles

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Daytime and nighttime concentration profiles have been assembled for the following neutral species: CO, CO_2, H, H_2, H_2O, H_2O_2, HNO_2, HNO_3, HO, HO_2, N, $N(^2D)$, NO, NO_2, N_2, N_2O, O, $O(^1D)$, O_2, $O_2(^1\Delta)$, $O_2(^1\Sigma)$ and O_3. Values for each species concentration are given in 5 km intervals for the altitude range 0-100 km.

O(1)D (1)DELTA (1)SIGMA N(2)D

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LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (CONTD)

SELECTED NEUTRAL SPECIES PROFILES, 0-100 km

The multispecies code AIRCHEM[1] has been used to understand and predict the charged particle composition of the earth's stratosphere and mesosphere under a variety of excitation conditions.[2-4] Such a code requires profiles of neutral species concentrations as input. The major species N_2 and O_2 present few problems. However, self-consistent profiles for most of the minor species were not and are not yet available. Recourse has been made to specific measurements, other model computations, interpolations, extrapolations and estimates. Table I and its attendant references describe the neutral species input values that have been used in the versions of the AIRCHEM code since 1974. No claim is made that these are necessarily self-consistent profiles. Fortunately, we have found that the minor species concentrations tend to be determined more by the chemistry than the initial profiles. (However, should reliable minor species profiles become available, they would provide additional checks or constraints on an atmospheric model.)

It is the purpose of this document to record those values that were and are actually used. Explanations as to why a particular set of values was chosen are beyond its scope. The basic data of this report is listed in Table I. The 39 accompanying profiles of each of the species used in the AIRCHEM code were generated from Table I using the standard CALCOMP interpolation scheme. (Note that CO listed in Table I has not been employed in this code.) Figures 1-21 are daytime profiles and Figures 22-39 are nighttime profiles. The initial profiles of N, $N(^2D)$ and $O(^1D)$ are taken to be zero at night.

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[1] E. L. Lortie, M. D. Kregel and F. E. Niles, "AIRCHEM: A Computational Technique for Modeling the Chemistry of the Atmosphere," BRL Report No. 1913, August 1976. (AD #A030157)

[2] F. E. Niles and J. M. Heimerl, "Computed Results for Disturbed Atmospheric Conditions in the Stratosphere and Mesosphere: $N_o - 10^{11}\ cm^{-3}$, $Q_o = 10^8$ ion-pairs $cm^{-3}s^{-1}$," BRL IMR No. 484, March 1976. To be published as BRL Report.

[3] F. E. Niles and J. M. Heimerl, "Computed Results for Disturbed Atmospheric Conditions at 60 km," July 1976. To be published as BRL Report.

[4] J. M. Heimerl and F. E. Niles, "Modeling of Charged Particle Chemistry in the Stratosphere and Mesosphere," Trans. Am. Geophys. Union 57, 303, 1976.

TABLE I. NEUTRAL COMPOSITION OF THE ATMOSPHERE BETWEEN 0 AND 100 KM

Number Densities (m^{-3})

Geometric Altitude (km)	T (K)	Ref/ Remarks	M‡	Ref/ Remarks	CO (Day & Night)	Ref/ Remarks	CO_2 (Day & Night)	Ref/ Remarks	H (Day)	Ref/ Remarks	H (Night)	Ref/ Remarks	HNO_2 (Day & Night)	Ref/ Remarks	HNO_3 (Day & Night)	Ref/ Remarks
0	288	1	2.55 [25]*	1	4.8 [18]	3,4	8.2 [21]	4	-				3.1 [14]	10	5.0 [16]	10
5	256	1	1.53 [25]	1	2.0 [18]	3,4	4.9 [21]	4	-		-		1.1 [14]	10	1.9 [16]	10
10	223	1	8.60 [24]	1	1.1 [18]	3,4,5,6	2.8 [21]	4	-		-		1.5 [13]	10	1.8 [16]	10
15	217	1	4.05 [24]	1	1.6 [17]	3,4,5,6	1.3 [21]	4	-		-		5.0 [12]	10	6.0 [16]	10
20	217	1	1.85 [24]	1	9.3 [15]	3	5.9 [20]	7	-		-		1.6 [12]	10	1.9 [16]	10
25	222	1,2	8.11 [23]	2	4.1 [15]	3	2.6 [20]	7	-		-		6.8 [11]	10	6.0 [15]	10
30	231	2	3.69 [23]	2	1.8 [15]	3	1.2 [20]	7	-		-		5.6 [11]	10	1.0 [15]	10
35	242	2	1.72 [23]	2	8.6 [14]	3	5.5 [19]	7	-		-		5.4 [11]	10	2.0 [14]	10
40	255	2	8.27 [22]	2	4.1 [14]	3	2.7 [19]	7	1.0 [10]	8	1.0 [10]	8	4.4 [11]	10	2.0 [13]	10
45	268	2	4.15 [22]	2	2.1 [14]	3	1.3 [19]	7	2.5 [11]	8	2.5 [11]	8	1.8 [11]	10	8.0 [11]	10
50	272	2	2.20 [22]	2	1.1 [14]	3	7.1 [18]	7	5.6 [11]	8	5.4 [11]	8	4.0 [10]	10	3.0 [10]	10
55	264	2	1.21 [22]	2	6.1 [13]	3	3.9 [18]	7	1.2 [12]	8	1.1 [12]	8	7.0 [9]	10	1.0 [9]	est
60	249	2	6.67 [21]	2	3.3 [13]	3	2.1 [18]	7	2.0 [12]	9	1.8 [12]	8	3.3 [9]	11	3.5 [7]	est
65	233	2	3.57 [21]	2	1.8 [13]	3	1.1 [18]	7	3.5 [12]	9	3.0 [12]	8	1.8 [9]	11	-	
70	216	2	1.82 [21]	2	9.1 [13]	7	5.8 [17]	7	3.1 [13]	9	5.6 [12]	8	9.1 [8]	11	-	
75	205	2	8.70 [20]	2	5.2 [14]	7	2.6 [17]	7	1.0 [14]	9	1.4 [13]	8	4.4 [8]	11	-	
80	195	2	3.96 [20]	2	9.1 [14]	7	1.2 [17]	7	2.5 [14]	9	1.5 [14]	9	2.0 [8]	11	-	
85	185	2	1.74 [20]	2	1.0 [15]	7	4.7 [16]	7	3.1 [14]	9	3.1 [14]	9	8.7 [7]	11	-	
90	184	2	7.09 [19]	2	7.1 [14]	7	1.7 [16]	7	2.5 [14]	9	2.5 [14]	9	3.5 [7]	11	-	
95	190	2	2.81 [19]	2	4.8 [14]	7	6.2 [15]	7	1.6 [14]	9	1.6 [14]	9	1.4 [7]	11	-	
100	204	2	1.13 [19]	2	2.5 [14]	7	2.3 [15]	7	1.1 [14]	9	1.1 [14]	9	5.7 [6]	11	-	

‡M denotes total number density.

*Read 2.55 [25] at 2.55 x 10^{25}. Values have been rounded off to three significant figures.

NEUTRAL COMPOSITION OF THE ATMOSPHERE BETWEEN 0 AND 100 KM (contd)

Number Densities (m^{-3})

Geometric Altitude (km)	HO (Day)	Ref/ Remarks	HO (Night)	Ref/ Remarks	HO_2 (Day)	Ref/ Remarks	HO_2 (Night)	Ref/ Remarks	H_2 (Day & Night)	Ref/ Remarks	H_2O (Day & Night)	Ref/ Remarks	H_2O_2 (Day)	Ref/ Remarks
0	5.4 [12]	10	-		9.0 [14]	10	-		1.27[19]	4	1.9 [23]	4	6.8 [16]	10
5	1.5 [12]	10*	-		1.4 [14]	10*	-		6.6 [18]	est	2.0 [22]	4	3.0 [15]	10*
10	3.9 [11]	10	1.6 [8]	12	2.7 [13]	10	5.0 [9]	12	3.3 [18]	est	5.9 [20]	4	2.7 [14]	10
15	8.4 [10]	10	4.2 [8]	12	1.0 [13]	10	3.5 [9]	12	1.8 [18]	est	2.1 [19]	4	8.5 [14]	10
20	3.0 [11]	10	2.5 [9]	12	1.5 [13]	10	6.0 [9]	12	9.3 [17]	14	7.8 [18]	15	1.3 [15]	10
25	6.3 [11]	10	2.5 [9]	12	2.1 [13]	10	6.0 [9]	12	4.6 [17]	14	3.4 [18]	15	1.8 [15]	10
30	1.3 [12]	10	8.0 [9]	12	2.2 [13]	10	1.7 [10]	12	1.8 [17]	14	1.5 [18]	15	1.2 [15]	10
35	3.0 [12]	10	8.5 [10]	12	1.5 [13]	10	1.2 [11]	12	8.6 [16]	14	7.2 [17]	15	2.8 [14]	10
40	6.5 [12]	10	2.0 [11]	12	8.9 [12]	10	2.4 [11]	12	4.1 [16]	14	3.5 [17]	15	4.0 [13]	10
45	6.7 [12]	10*	2.0 [11]	12	6.1 [12]	10*	2.3 [11]	12	2.1 [16]	14	1.7 [17]	15	1.3 [13]	10*
50	7.1 [12]	10	2.0 [11]	12	4.5 [12]	10	1.6 [11]	13	1.1 [16]	14	9.2 [16]	15	4.4 [12]	10
55	5.1 [12]	10*	1.1 [11]	8	3.2 [12]	10*	1.0 [11]	13	6.1 [15]	14	5.1 [16]	15	1.9 [12]	10*
60	3.8 [12]	10	7.0 [10]	8	2.1 [12]	10	7.5 [10]	13	3.3 [15]	14	2.8 [16]	15	8.1 [11]	10
65	3.0 [12]	10*	5.6 [10]	8	1.5 [12]	10*	1.2 [11]	13	2.8 [15]	est	1.0 [16]	9	4.0 [11]	10*
70	2.3 [12]	10	5.6 [10]	8	1.1 [12]	10	1.5 [11]	13	2.4 [15]	est	5.0 [15]	9	1.9 [11]	10
75	1.1 [12]	10*	3.0 [12]	8	9.0 [11]	10*	1.1 [11]	13	2.0 [15]	9	1.6 [15]	9	3.6 [10]	10*
80	5.4 [11]	10	1.0 [12]	8	2.0 [11]	10	5.0 [8]	13	1.0 [15]	9	5.0 [14]	9	6.5 [9]	10
85	6.0 [10]	est	1.0 [11]	8	1.0 [10]	est	2.0 [7]	13	5.0 [14]	9	1.6 [14]	9	7.0 [7]	est
90	3.0 [9]	est	1.3 [10]	8	7.0 [8]	est	1.4 [6]	13	1.8 [14]	9	4.0 [13]	9	2.0 [6]	est
95	1.0 [9]	est	2.5 [9]	8	5.0 [7]	est	1.2 [5]	13	7.0 [13]	9	1.4 [13]	9	3.0 [4]	est
100	1.0 [8]	est	5.6 [8]	8	3.0 [6]	est	1.0 [4]	13	3.2 [13]	9	4.0 [12]	9	5.0 [2]	est

*Logarithmic interpolation

NEUTRAL COMPOSITION OF THE ATMOSPHERE BETWEEN 0 AND 100 KM (contd)

Number Densities (m^{-3})

Geometric Altitude (km)	H_2O_2 (Night)	Ref/ Remarks	N (Day)	Ref/ Remarks	N (Night)	Ref/ Remarks	NO (Day)	Ref/ Remarks	NO (Night)	Ref/ Remarks	NO_2 (Day)	Ref/ Remarks	NO_2 (Night)	Ref/ Remarks
0	-		-		-		1.27[16]	4	-		2.55[16]	4	-	
5	-		-		-		7.0 [15]	10	-		1.0 [16]	10	-	
10	3.1 [13]	12	-		-		2.3 [15]	10	4.5 [9]	12	1.6 [15]	10	3.9 [15]	23
15	1.0 [13]	12	-		-		4.0 [15]	10	1.4 [9]	12	1.6 [15]	10	5.6 [15]	23
20	1.0 [13]	12	-		-		2.0 [15]	16	3.0 [8]	12	1.0 [15]	22	3.0 [15]	23
25	1.3 [13]	12	-		-		2.0 [15]	16	1.8 [7]	12	2.2 [15]	22	4.2 [15]	23
30	2.0 [13]	12	-		-		2.0 [15]	16	5.6 [5]	est	1.8 [15]	22	3.8 [15]	23
35	1.3 [13]	12	-		-		1.0 [15]	16	4.0 [3]	est	1.3 [15]	22	2.3 [15]	23
40	1.1 [13]	12	1.0 [9]	8	-		8.0 [14]	16	1.0 [4]	est	4.0 [14]	22	1.2 [15]	23
45	1.3 [13]	12	1.1 [9]	8	-		5.5 [14]	10	6.0 [5]	est	7.0 [13]	10	6.2 [14]	23
50	5.5 [13]	12	1.2 [9]	8	-		2.8 [14]	10	4.0 [6]	8	7.0 [12]	10	2.9 [14]	23
55	8.0 [12]	est	1.8 [9]	8	-		1.4 [14]	10	1.0 [10]	8	7.0 [11]	10	1.4 [14]	23
60	2.0 [12]	9	3.3 [9]	8	-		5.6 [13]	10	2.0 [12]	8	7.0 [10]	10	5.4 [13]	23
65	4.5 [11]	9	6.2 [9]	8	-		3.3 [13]	18	9.0 [12]	8	7.0 [9]	8	2.4 [13]	23
70	6.5 [12]	9	2.0 [10]	8	-		3.8 [13]	18	2.0 [13]	8	7.0 [8]	8	1.8 [13]	23
75	3.1 [13]	9	5.0 [10]	8	-		5.2 [13]	18	5.2 [13]	18	1.4 [8]	8	-	
80	2.0 [13]	9	6.2 [10]	8	-		6.3 [13]	18	6.3 [13]	18	2.4 [7]	8	-	
85	1.8 [10]	9	9.0 [10]	8	-		6.3 [13]	18	6.3 [13]	18	6.0 [6]	8	-	
90	2.5 [6]	9	1.0 [11]	8	-		6.2 [13]	18	6.2 [13]	18	1.3 [6]	8	-	
95	-		1.0 [11]	8	-		6.0 [13]	18	6.0 [13]	18	3.0 [5]	8	-	
100	-		1.0 [11]	8	-		5.5 [13]	18	5.5 [13]	18	5.0 [4]	8	-	

NEUTRAL COMPOSITION OF THE ATMOSPHERE BETWEEN 0 AND 100 KM (contd)

Number Densities (m^{-3})

Geometric Altitude (km)	N_2 (Day & Night)	Ref/ Remarks	N_2O (Day & Night)	Ref/ Remarks	O (Day)	Ref/ Remarks	O (Night)	Ref/ Remarks	O_2 (Day & Night)	Ref/ Remarks	O_3 (Day)	Ref/ Remarks	O_3 (Night)	Ref/ Remarks
0	1.99 [25]	24	6.88 [18]	4	-		-		5.36 [24]	28	1.02 [18]	4	1.02 [18]	4
5	1.19 [25]	24	4.13 [18]	4	-		-		3.21 [24]	28	5.6 [17]	4	5.6 [17]	4
10	6.71 [24]	24	2.32 [18]	4	-		-		1.81 [24]	28	1.13 [18]	4	1.13 [18]	4
15	3.16 [24]	24	1.01 [18]	4	1.5 [9]	est	-		8.51 [23]	28	2.6 [18]	4	2.6 [18]	4
20	1.44 [24]	24	1.9 [16]	25	1.8 [10]	27	-		3.89 [23]	28	4.77 [18]	4	4.77 [18]	4
25	6.33 [23]	24	8.1 [15]	25	7.0 [11]	27	-		1.70 [23]	28	4.3 [18]	4	4.3 [18]	4
30	2.88 [23]	24	3.7 [15]	25	4.0 [12]	27	-		7.75 [22]	28	2.52 [18]	4	2.52 [18]	4
35	1.34 [23]	24	1.7 [15]	25	7.0 [13]	est	-		3.61 [22]	28	1.34 [18]	4	1.34 [18]	4
40	6.45 [22]	24	8.3 [14]	25	1.0 [15]	8	1.4 [6]	8	1.74 [22]	28	6.08 [17]	4	6.08 [17]	4
45	3.24 [22]	24	4.2 [14]	25	3.2 [15]	8	1.7 [6]	8	8.72 [21]	28	2.2 [17]	4	3.1 [17]	8
50	1.72 [22]	24	2.2 [14]	25	5.6 [15]	8	2.2 [6]	8	4.62 [21]	28	6.65 [16]	4	1.2 [17]	8
55	9.44 [21]	24	1.2 [14]	25	1.0 [16]	8	2.5 [6]	8	2.54 [21]	28	2.1 [16]	4	6.0 [16]	8
60	5.20 [21]	24	6.7 [13]	25	1.4 [16]	8	5.6 [6]	8	1.40 [21]	28	7.35 [15]	4	3.2 [16]	8
65	2.78 [21]	24	3.6 [13]	25	1.8 [16]	8	3.1 [7]	8	7.50 [20]	28	2.4 [15]	4	1.6 [16]	8
70	1.42 [21]	24	1.8 [13]	25	1.4 [16]	8	4.0 [8]	8	3.82 [20]	28	5.46 [14]	4	9.0 [15]	8
75	6.79 [20]	2	8.7 [12]	25	1.0 [16]	8	1.0 [11]	8	1.82 [20]	2	4.0 [14]	est	6.0 [13]	8
80	3.10 [20]	2	4.0 [12]	25	6.22 [16]	2	2.0 [16]	8	8.20 [19]	2	3.13 [14]	2	5.0 [13]	8
85	1.36 [20]	2	1.7 [12]	25	1.39 [17]	2	1.39 [17]	2	3.55 [19]	2	1.25 [14]	2	8.0 [14]	8
90	5.58 [19]	2	7.1 [11]	25	1.66 [17]	2	1.66 [17]	2	1.42 [19]	2	2.66 [13]	2	4.5 [14]	8
95	2.22 [19]	2	2.8 [11]	25	1.91 [17]	2	1.91 [17]	2	5.48 [18]	2	4.62 [12]	2	1.2 [14]	8
100	8.71 [18]	2	1.1 [11]	25	4.15 [17]	2	4.15 [17]	2	1.99 [18]	2	1.26 [12]	2	2.2 [13]	8

NEUTRAL COMPOSITION OF THE ATMOSPHERE BETWEEN 0 AND 100 KM (contd)

Number Densities (m^{-3})

Geometric Altitude (km)	$N(^2D)$ (Day)	Ref/ Remarks	$N(^2D)$ (Night)	Ref/ Remarks	$O(^1D)$ (Day)	Ref/ Remarks	$O(^1D)$ (Night)	Ref/ Remarks	$O_2(^1\Delta)$ (Day)	Ref/ Remarks	$O_2(^1\Delta)$ (Night)	Ref/ Remarks	$O_2(^1\Sigma)$ (Day)	Ref/ Remarks	$O_2(^1\Sigma)$ (Night)	Ref/ Remarks
0	-		-		2.0 [3]	29	-		-		-		-		-	
5	-		-		3.0 [3]	29	-		-		-		-		-	
10	-		-		1.0 [4]	29	-		6.3 [11]	est	-		-		-	
15	-		-		6.0 [4]	29	-		1.2 [12]	27	-		-		-	
20	-		-		4.6 [5]	29	-		5.0 [12]	27	-		4.0 [9]	est	-	
25	-		-		2.5 [6]	est	-		3.5 [13]	27	-		2.5 [10]	est	-	
30	-		-		1.6 [7]	est	-		1.0 [15]	30	-		1.5 [11]	31	-	
35	-		-		1.0 [8]	est	-		2.3 [15]	30	-		8.0 [11]	31	-	
40	-		-		5.0 [8]	8	-		5.8 [15]	30	-		4.0 [12]	31	-	
45	-		-		7.0 [8]	8	-		1.9 [16]	30	-		4.0 [12]	31	-	
50	-		-		7.0 [8]	8	-		2.8 [16]	30	-		4.0 [12]	est	-	
55	-		-		7.0 [8]	8	-		2.2 [16]	30	-		4.0 [12]	est	-	
60	-		-		7.0 [8]	8	-		1.5 [16]	30	-		4.0 [12]	9	-	
65	-		-		4.5 [8]	8	-		9.6 [15]	30	-		3.0 [12]	9	-	
70	-		-		1.8 [8]	8	-		6.3 [15]	30	5.5 [6]	9	1.2 [12]	9	-	
75	-		-		6.5 [7]	8	-		3.2 [15]	30	6.3 [8]	9	1.0 [12]	9	-	
80	-		-		1.5 [8]	8	-		2.2 [15]	30	1.7 [11]	9	9.0 [11]	9	1.0 [7]	9
85	-		-		4.3 [8]	8	-		3.2 [15]	30	3.5 [14]	9	9.5 [11]	9	5.6 [10]	9
90	1.0 [6]	9	-		5.5 [8]	8	-		1.0 [15]	30	4.0 [14]	9	6.6 [11]	9	1.0 [11]	9
95	1.0 [7]	9	-		1.3 [9]	8	-		1.6 [14]	9	1.0 [14]	9	6.0 [11]	9	3.2 [10]	9
100	7.0 [7]	9	-		3.2 [9]	8	-		1.8 [13]	9	1.7 [13]	9	9.0 [11]	9	7.0 [9]	9

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13. HO_2 nighttime profile of Reference 8 reduced by 10^{-2} to fit with Reference 12.

14. Between 20 and 60 km, $[H_2] = 5 \times 10^{-7}$ [M] in accordance with Reference 10.

15. Between 20 and 60 km, $[H_2O] = 4.2 \times 10^{-6}$ [M] in accordance with Reference 10.

16. Profile for NO of Reference 10 raised to fit measurement of 2×10^{15} M^{-3} of Reference 17.

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22. NO_2 profile of Reference 10 reduced according to increase in NO profile.

23. $[NO_2]_{night} = [NO]_{day} + [NO_2]_{day} - [NO]_{night}$.

24. $[N_2] = 0.78$ [M].

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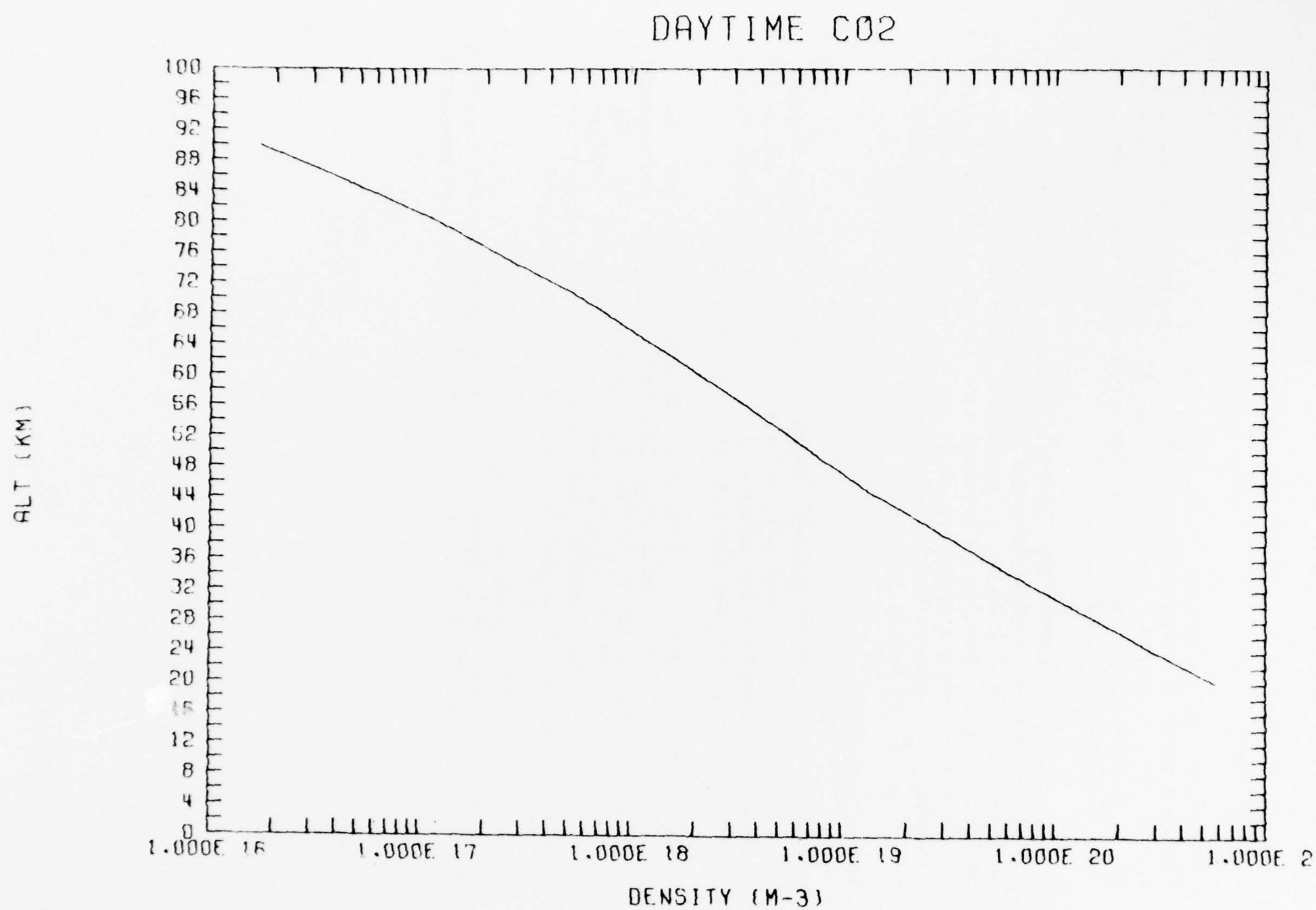

Figure 1. CO_2 daytime profile.

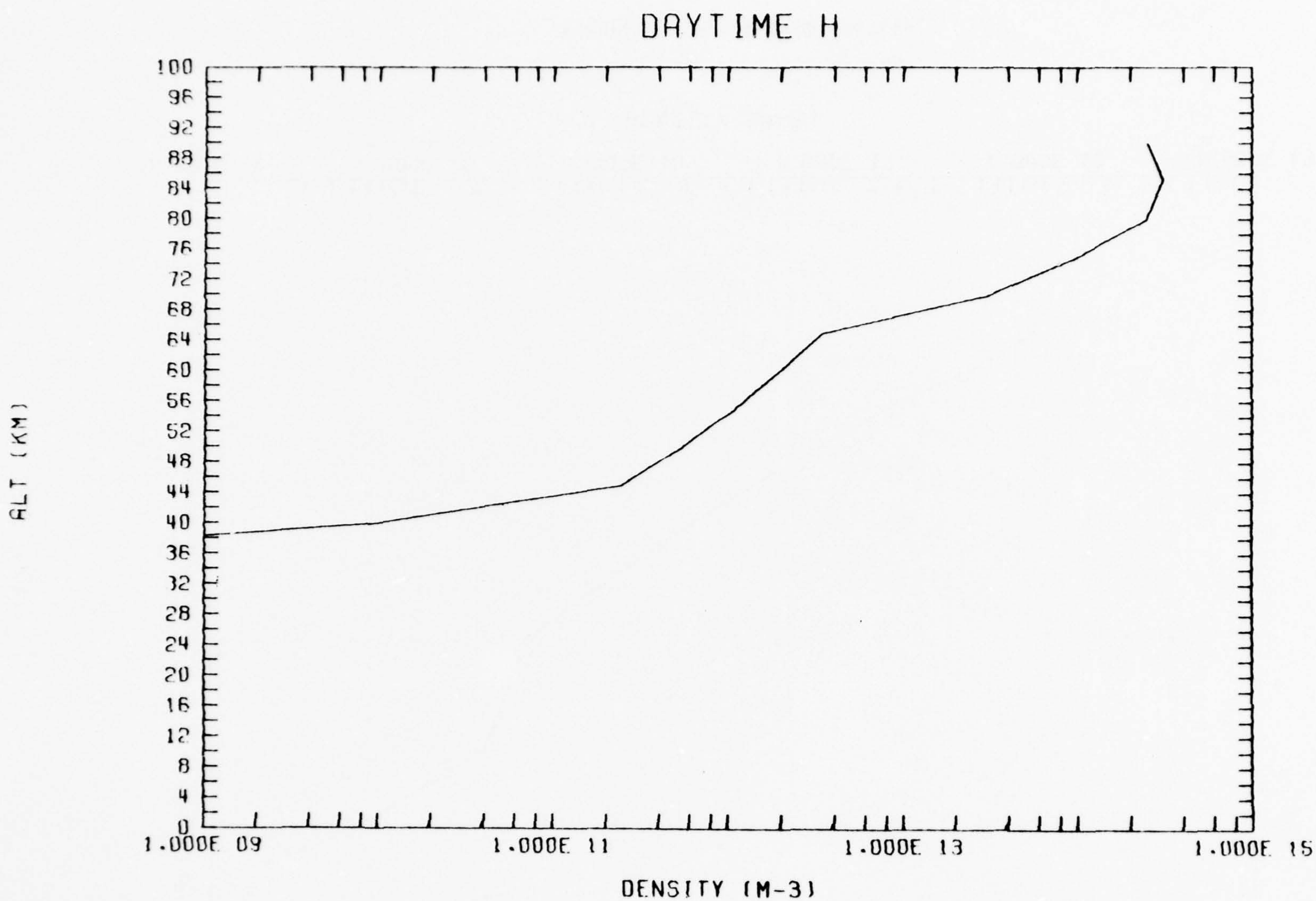

Figure 2. H daytime profile.

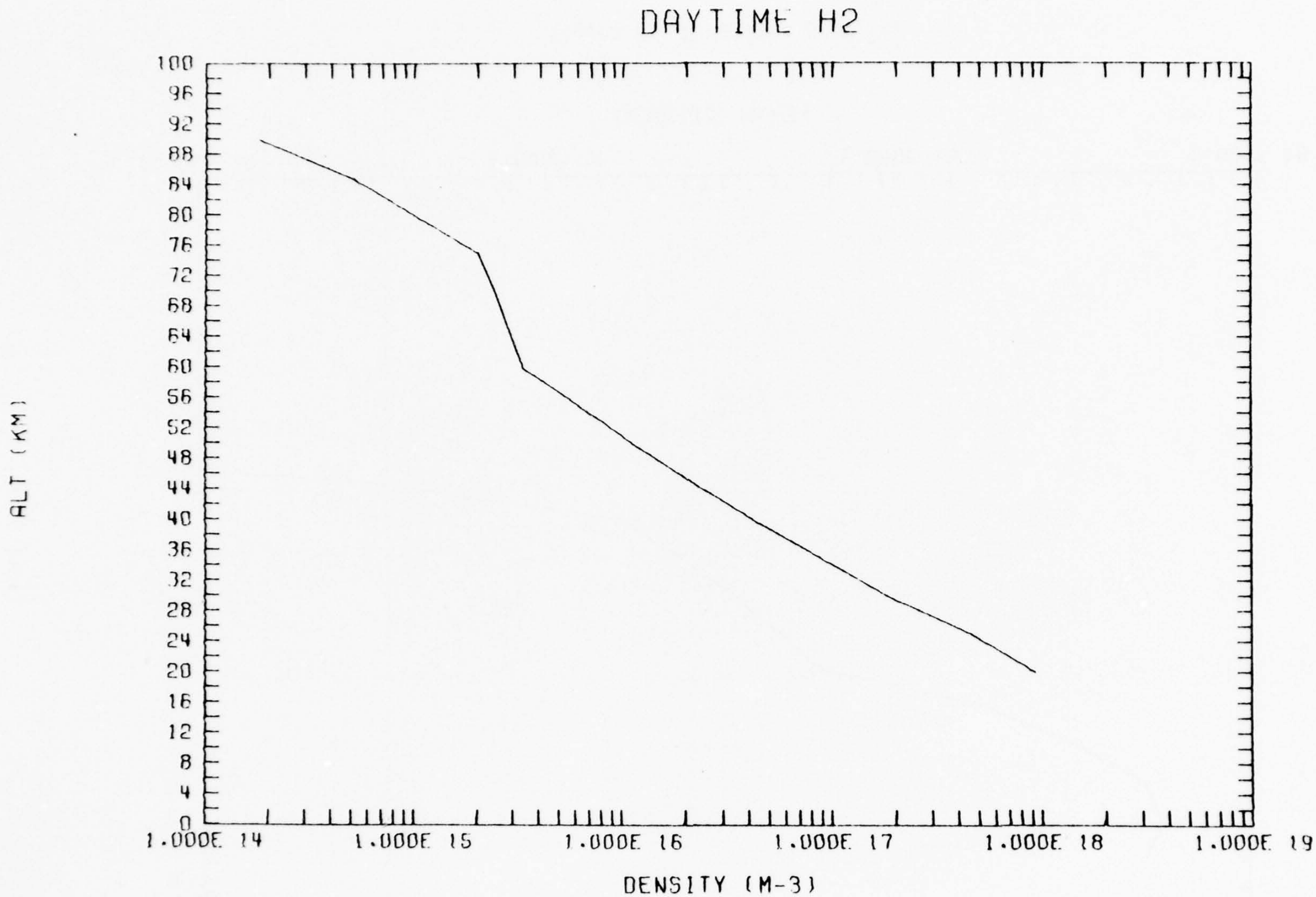

Figure 3. H_2 daytime profile.

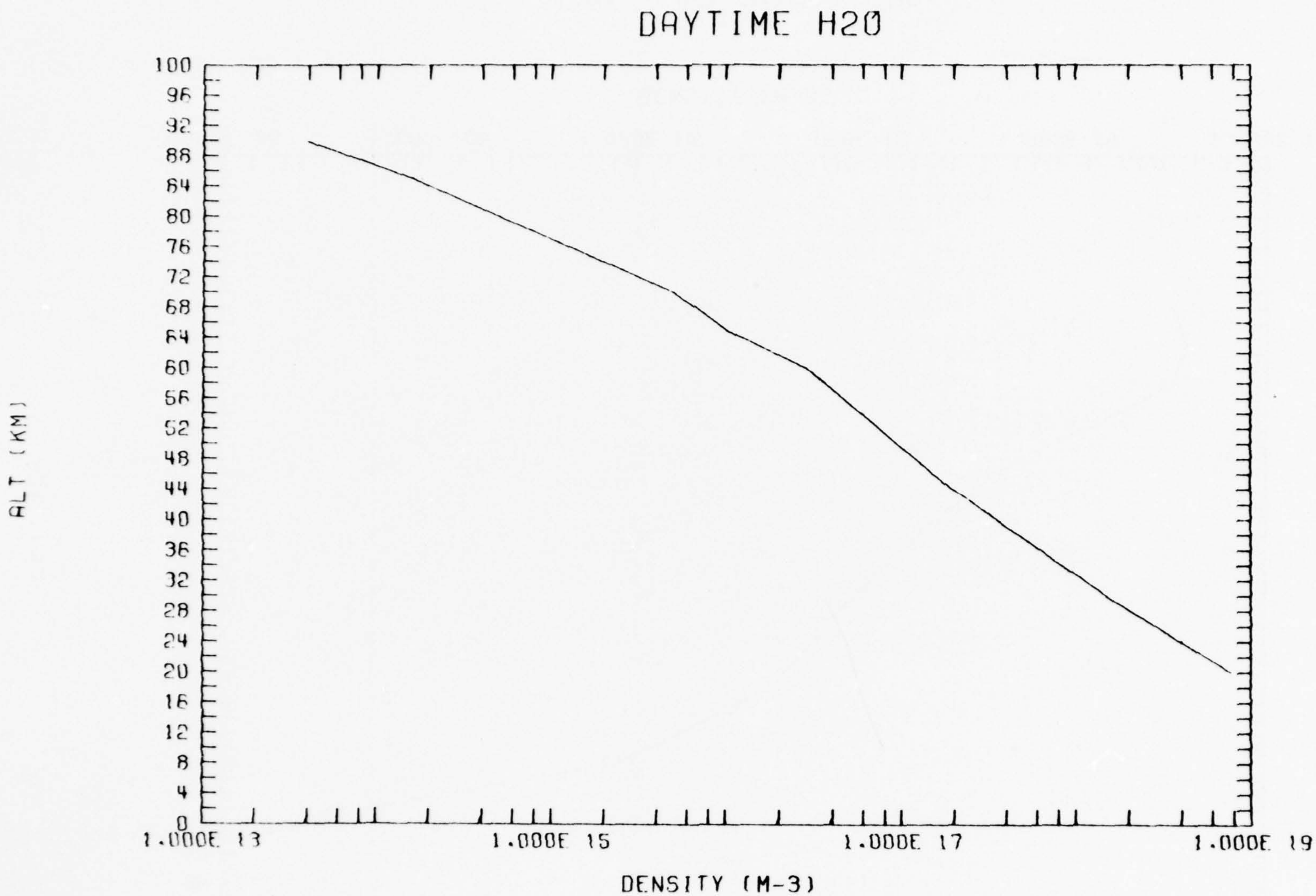

Figure 4. H_2O daytime profile.

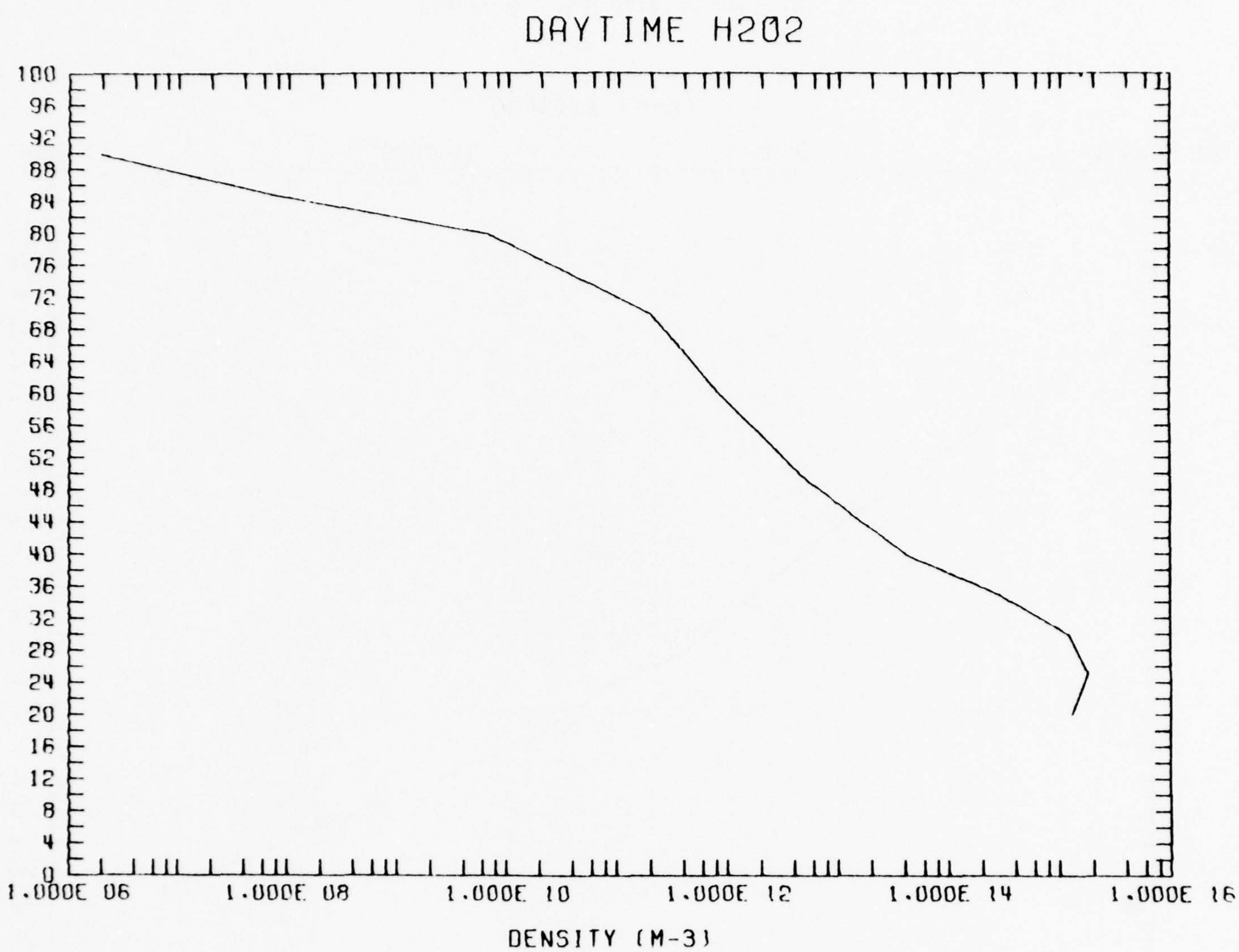

Figure 5. H_2O_2 daytime profile.

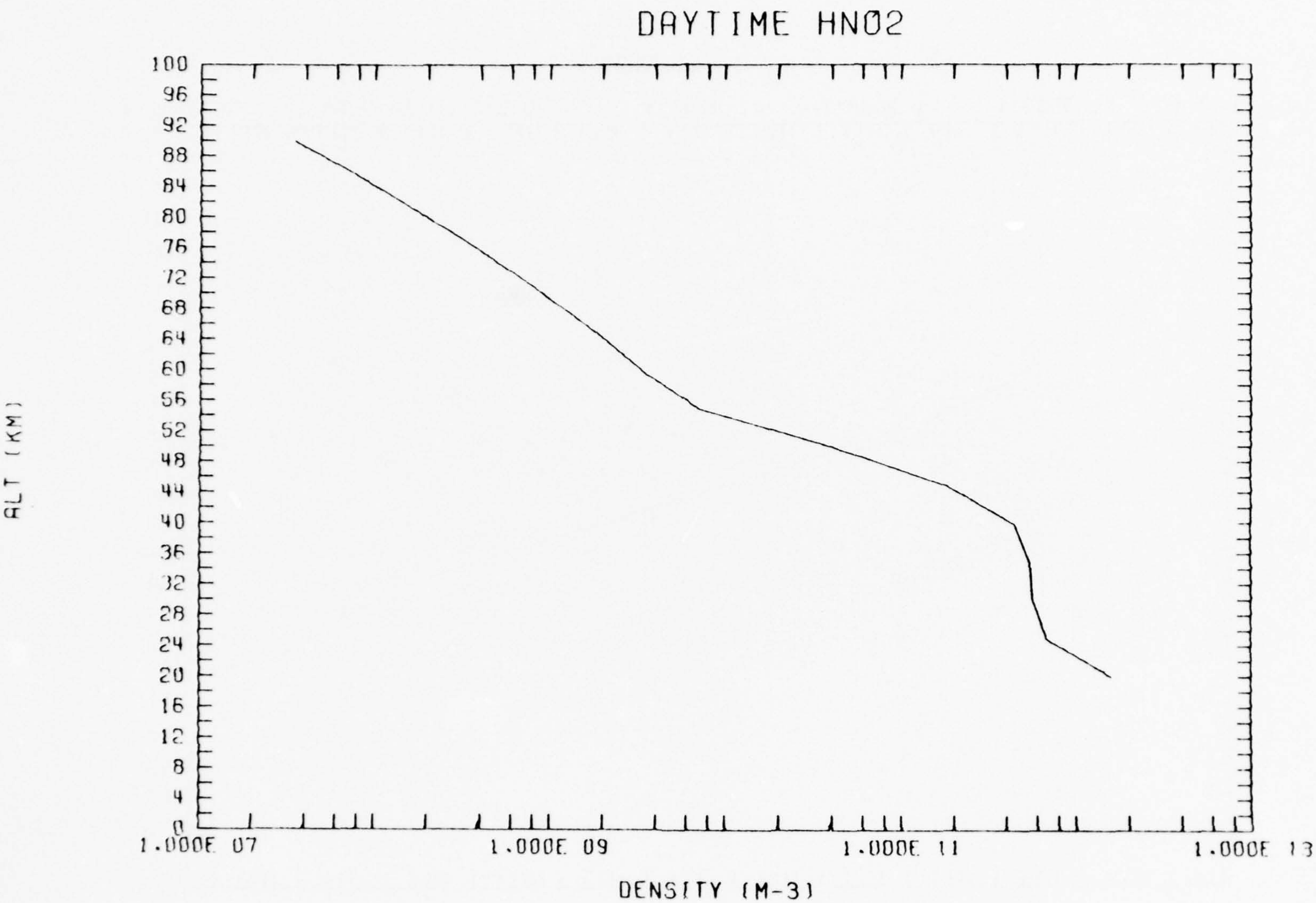

Figure 6. HNO_2 daytime profile.

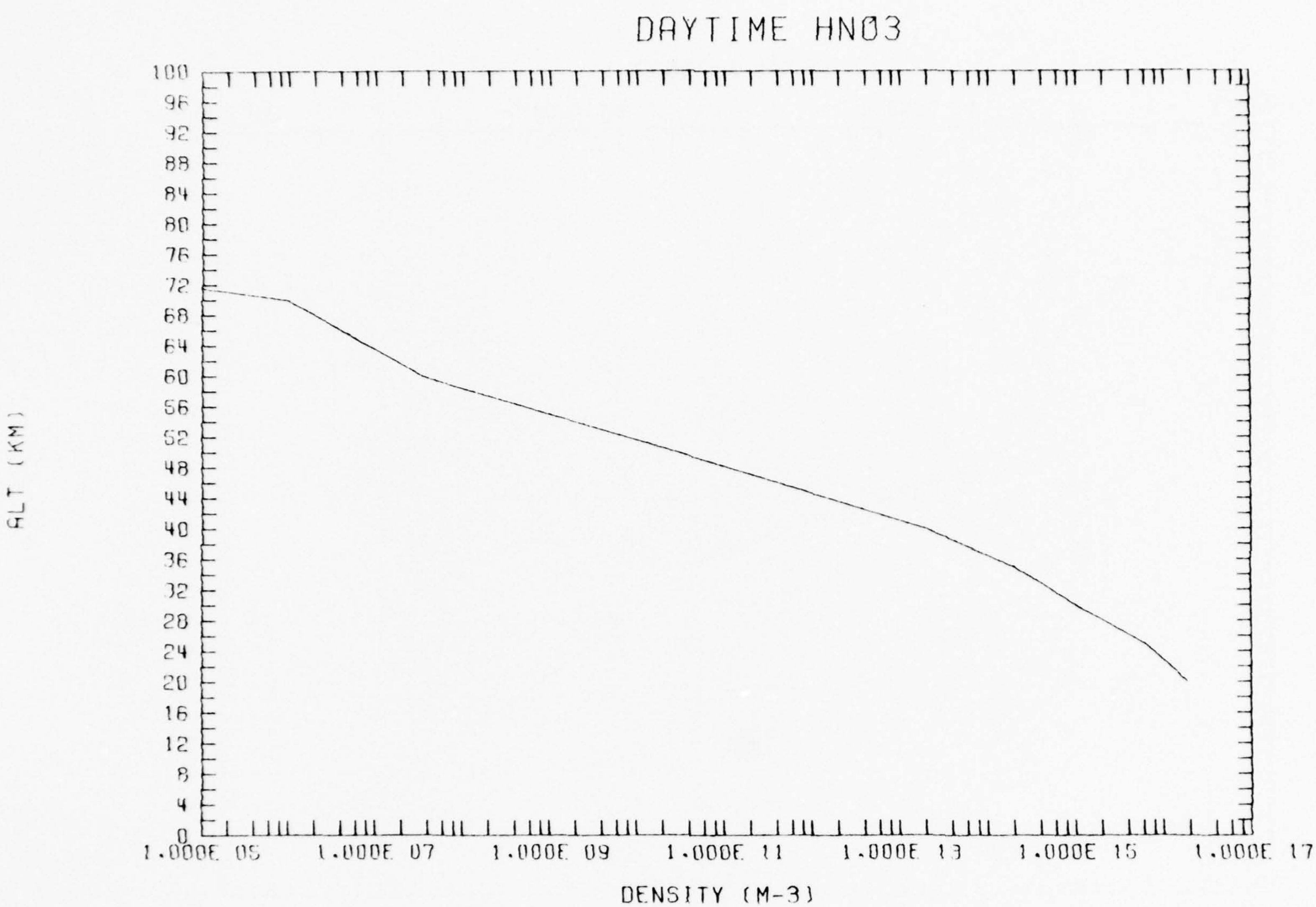

Figure 7. HNO_3 daytime profile.

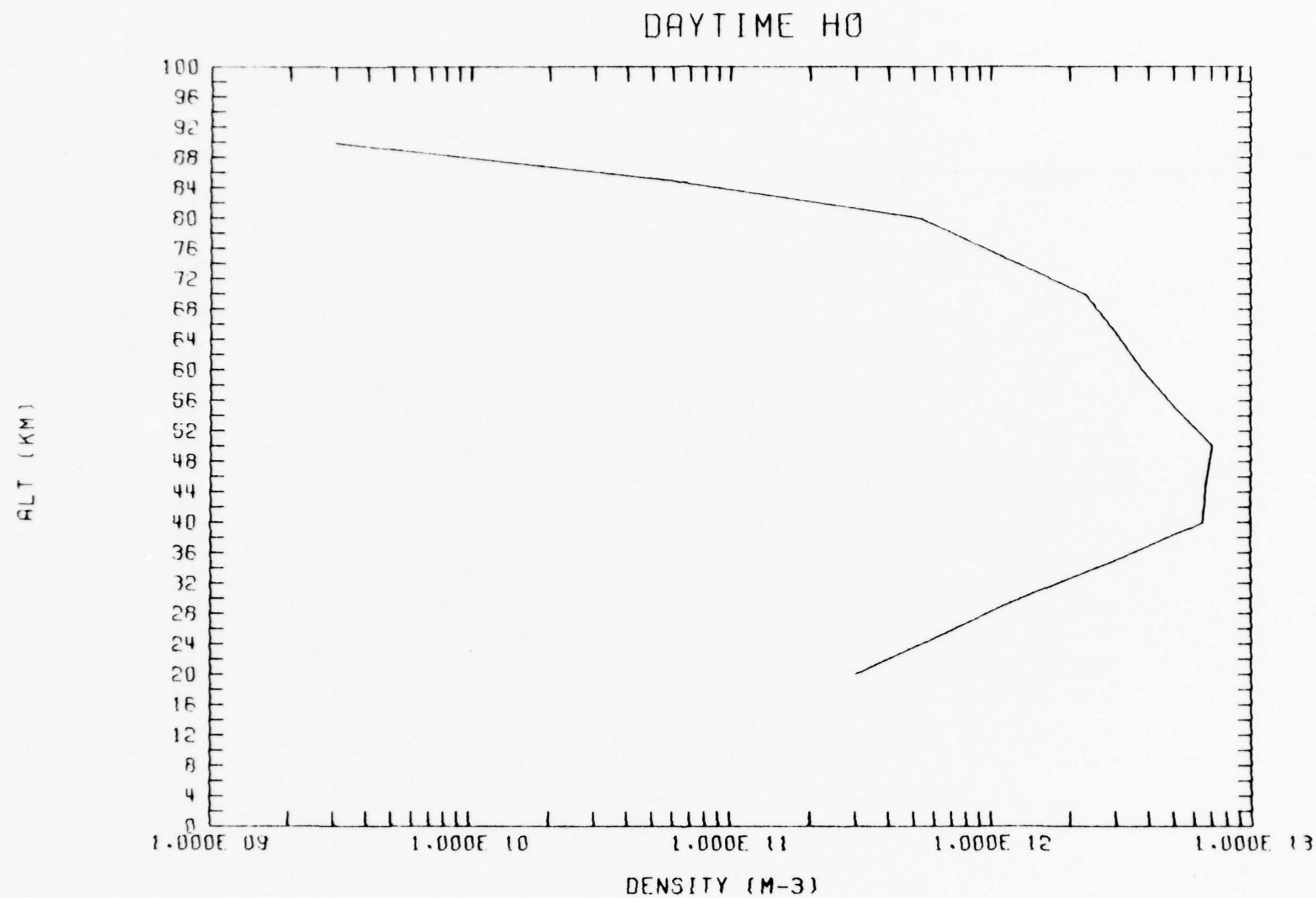

Figure 8. HO daytime profile.

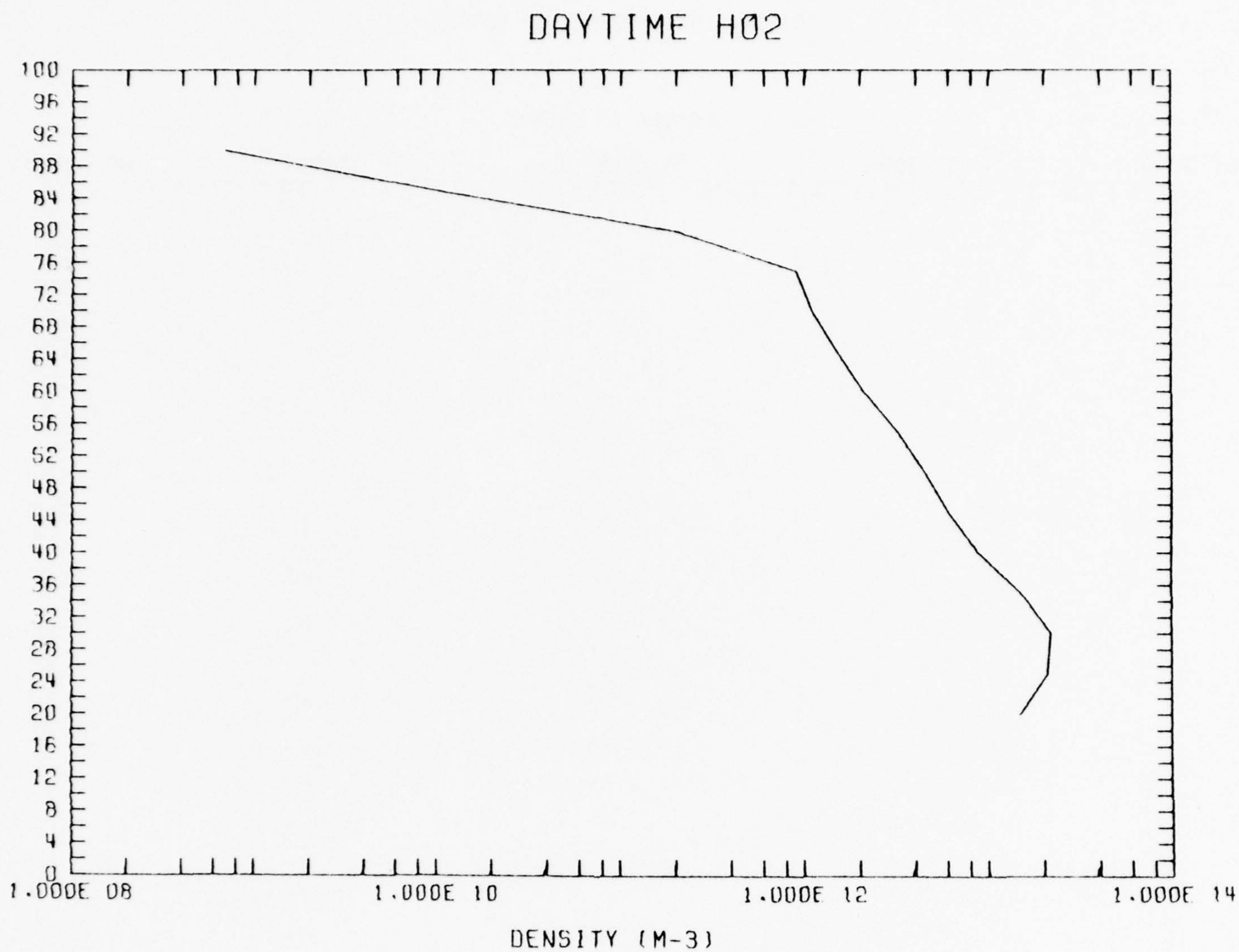

Figure 9. HO_2 daytime profile.

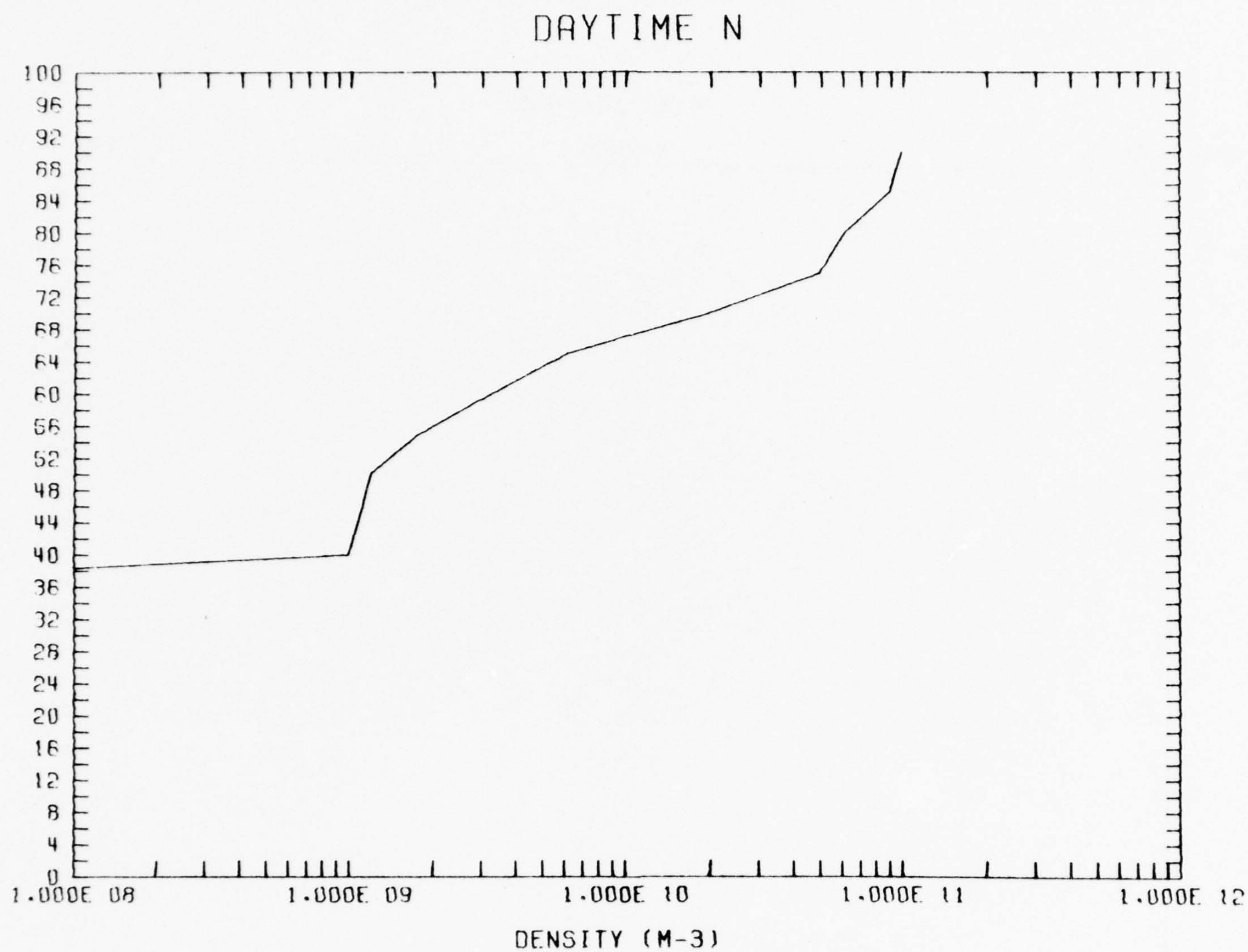

Figure 10. $N(^4S^0)$ daytime profile.

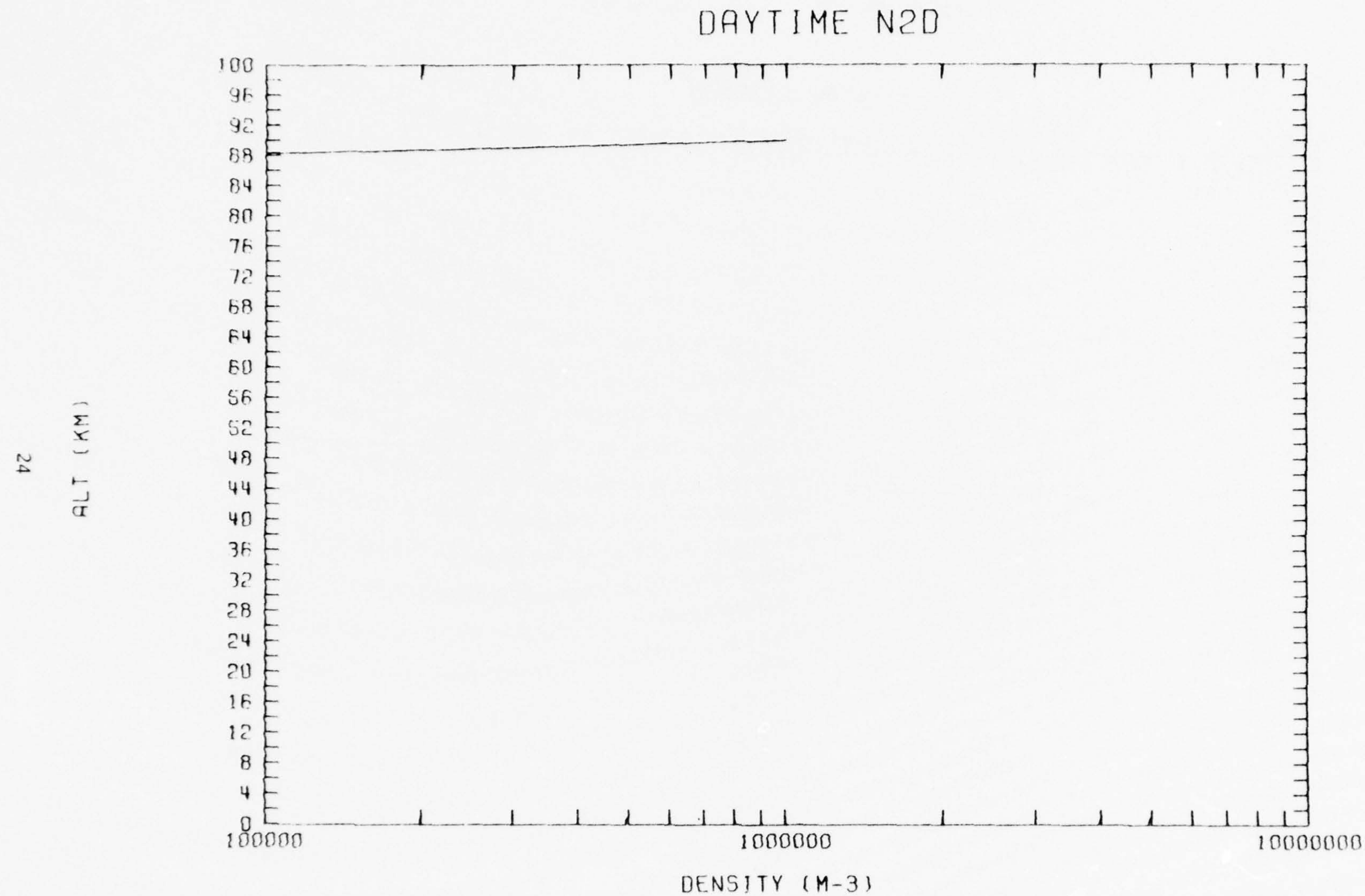

Figure 11. N(^{2}D) daytime profile.

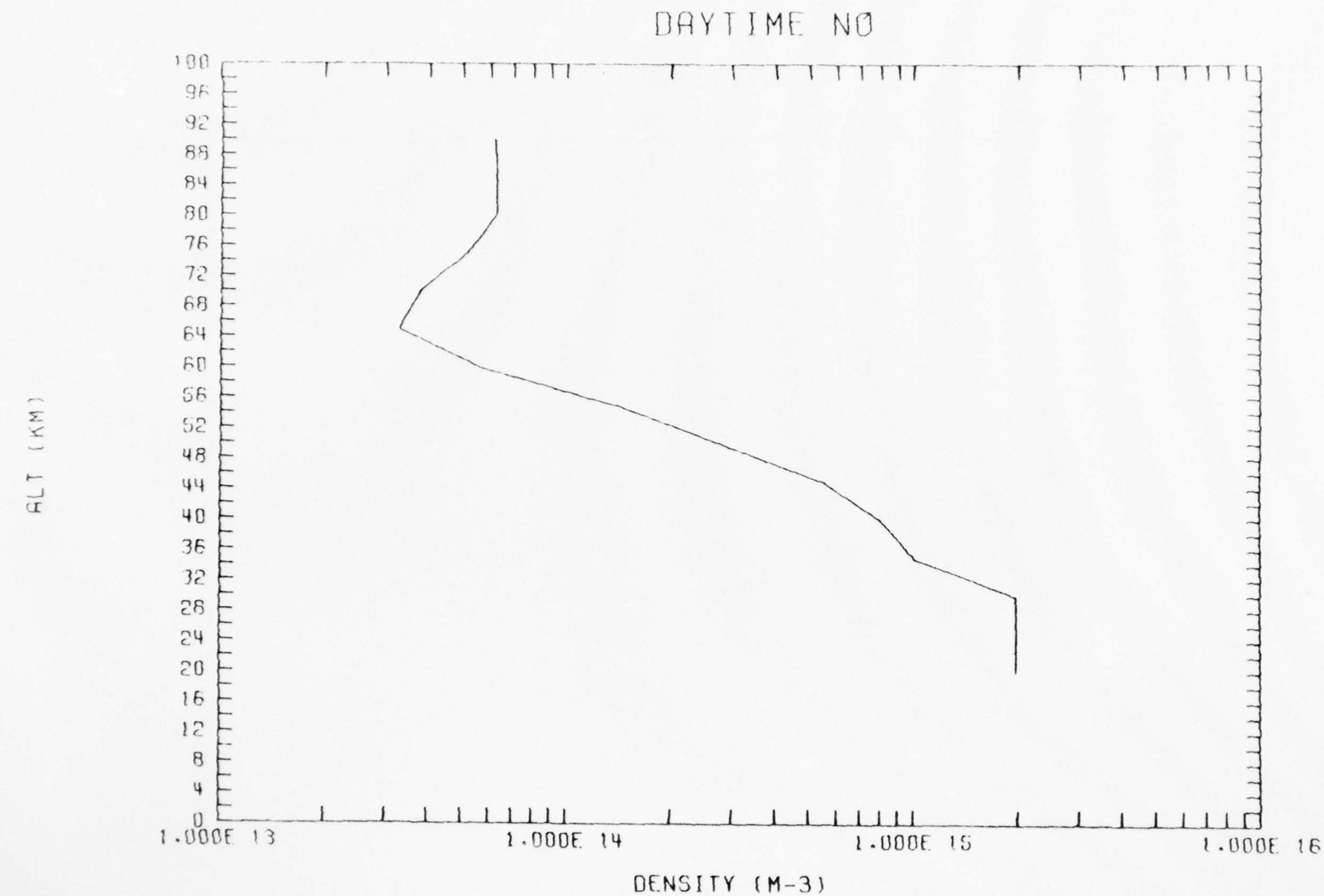

Figure 12. NO daytime profile.

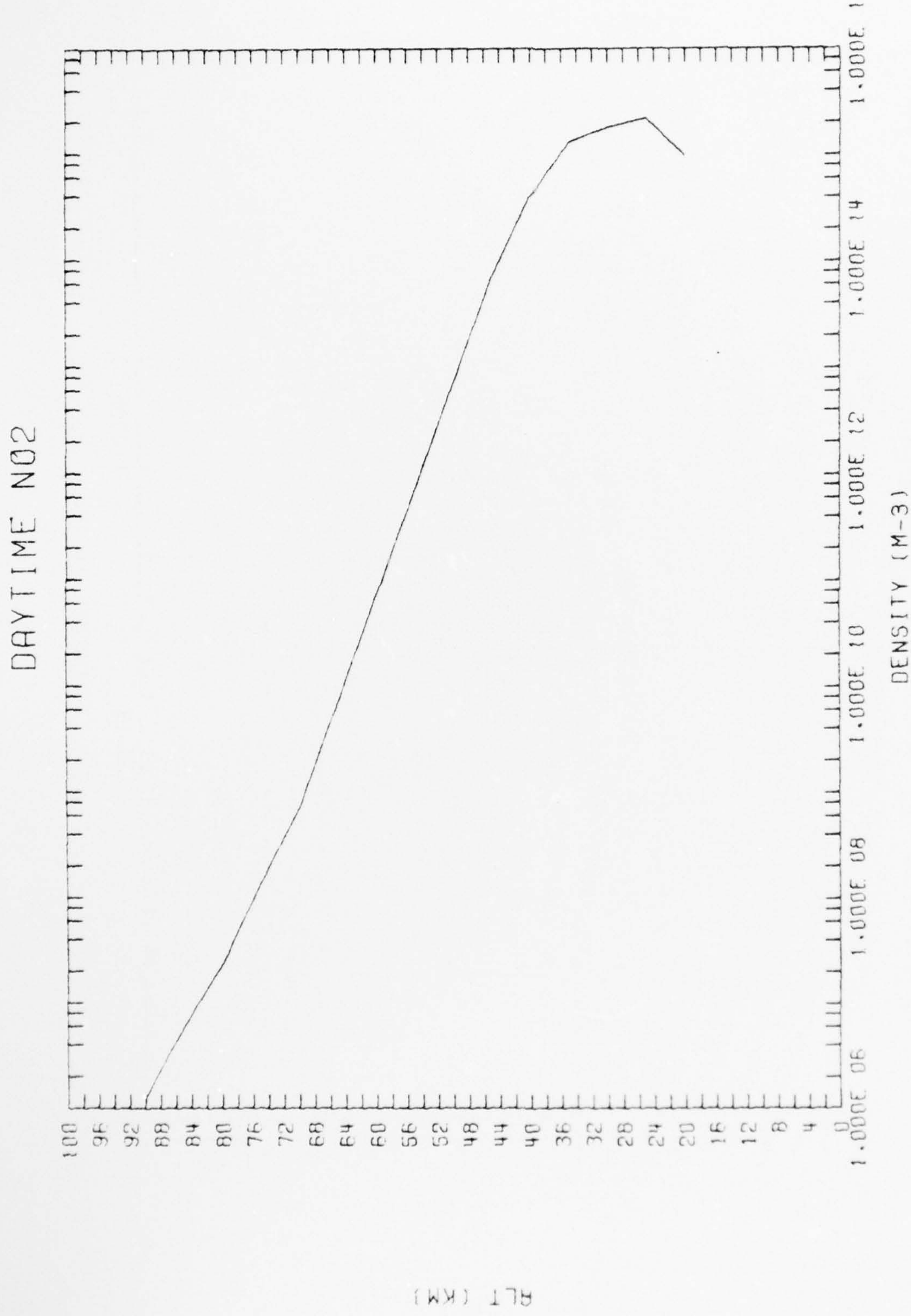

Figure 13. NO_2 daytime profile.

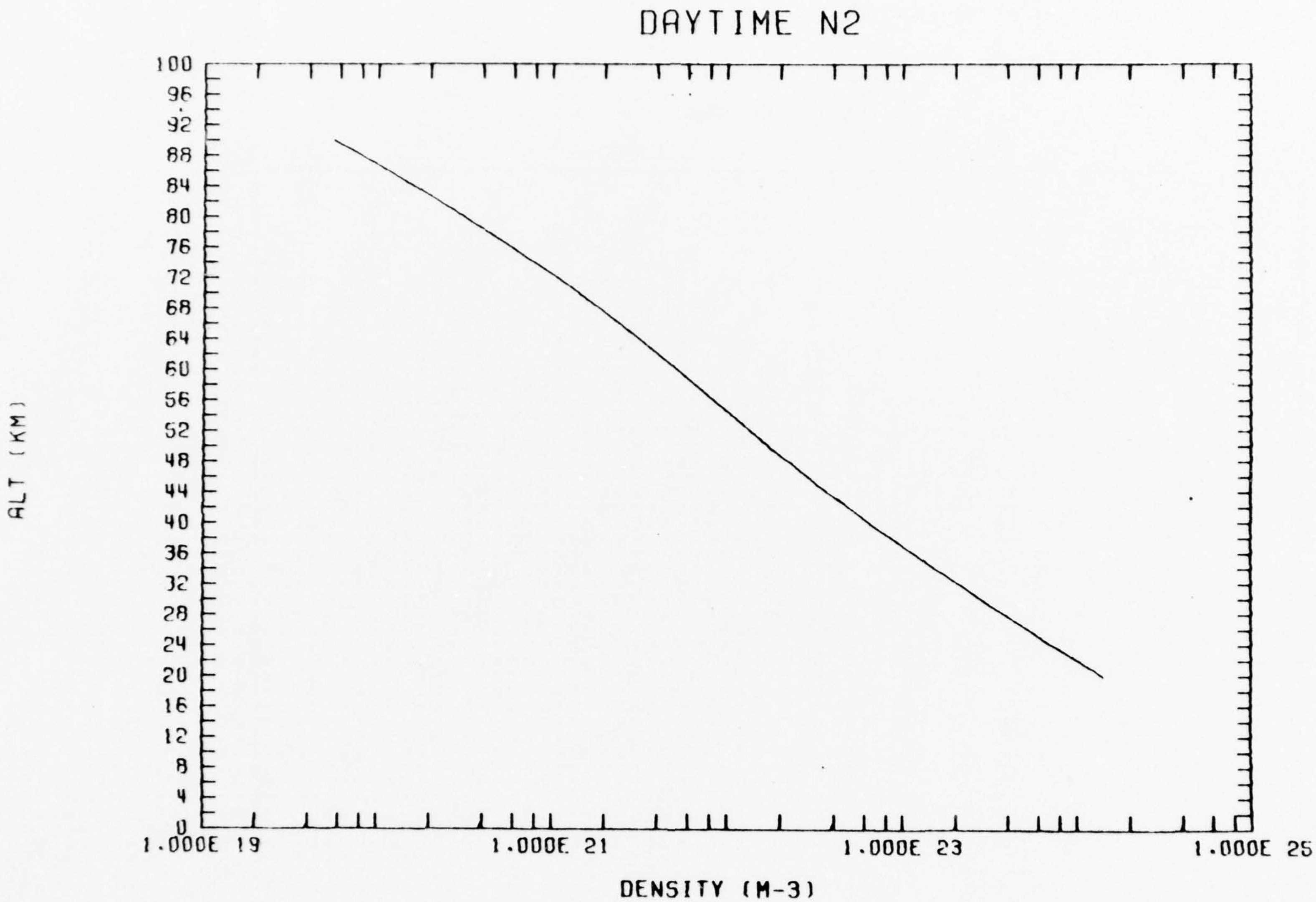

Figure 14. N_2 daytime profile.

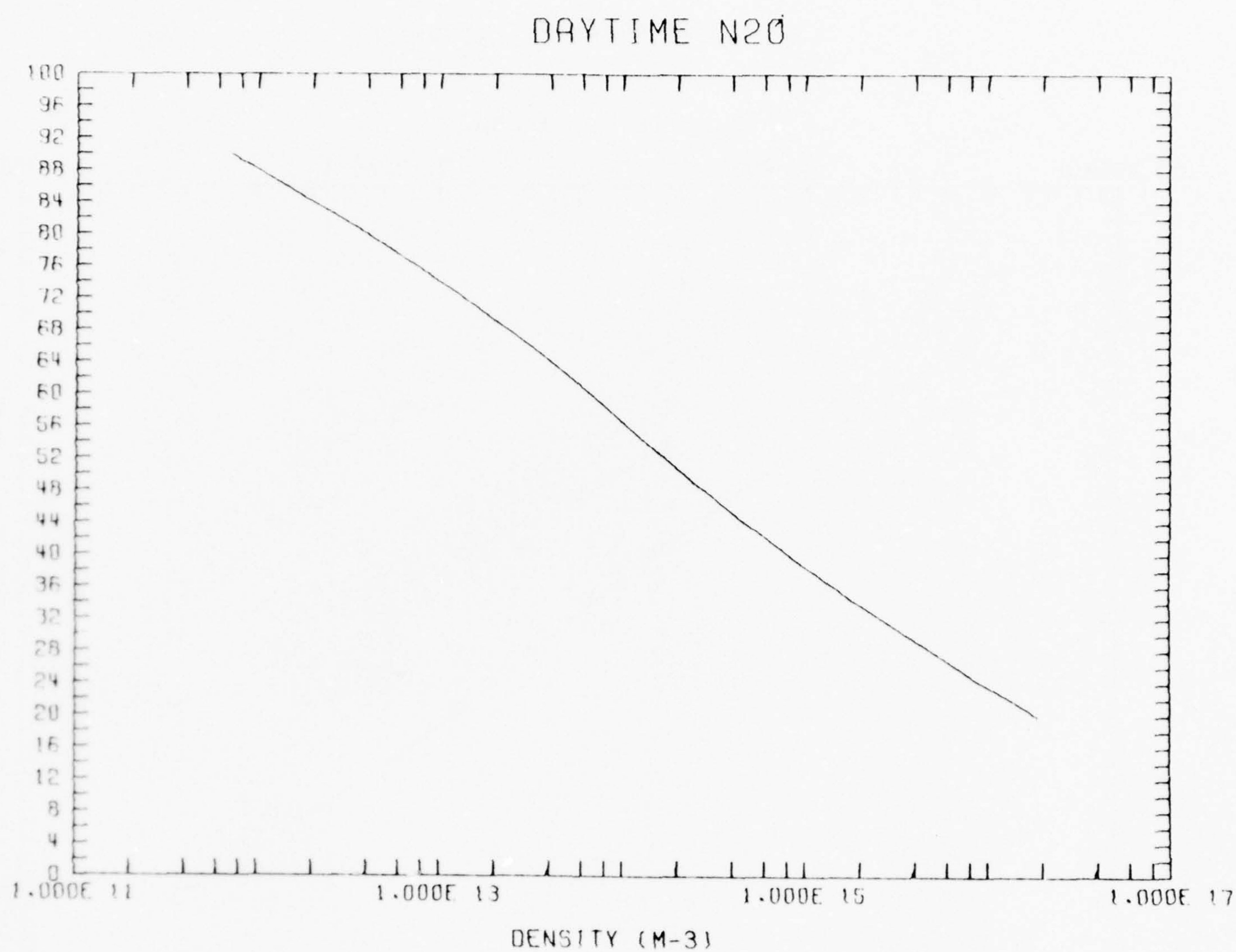

Figure 15. N_2O daytime profile.

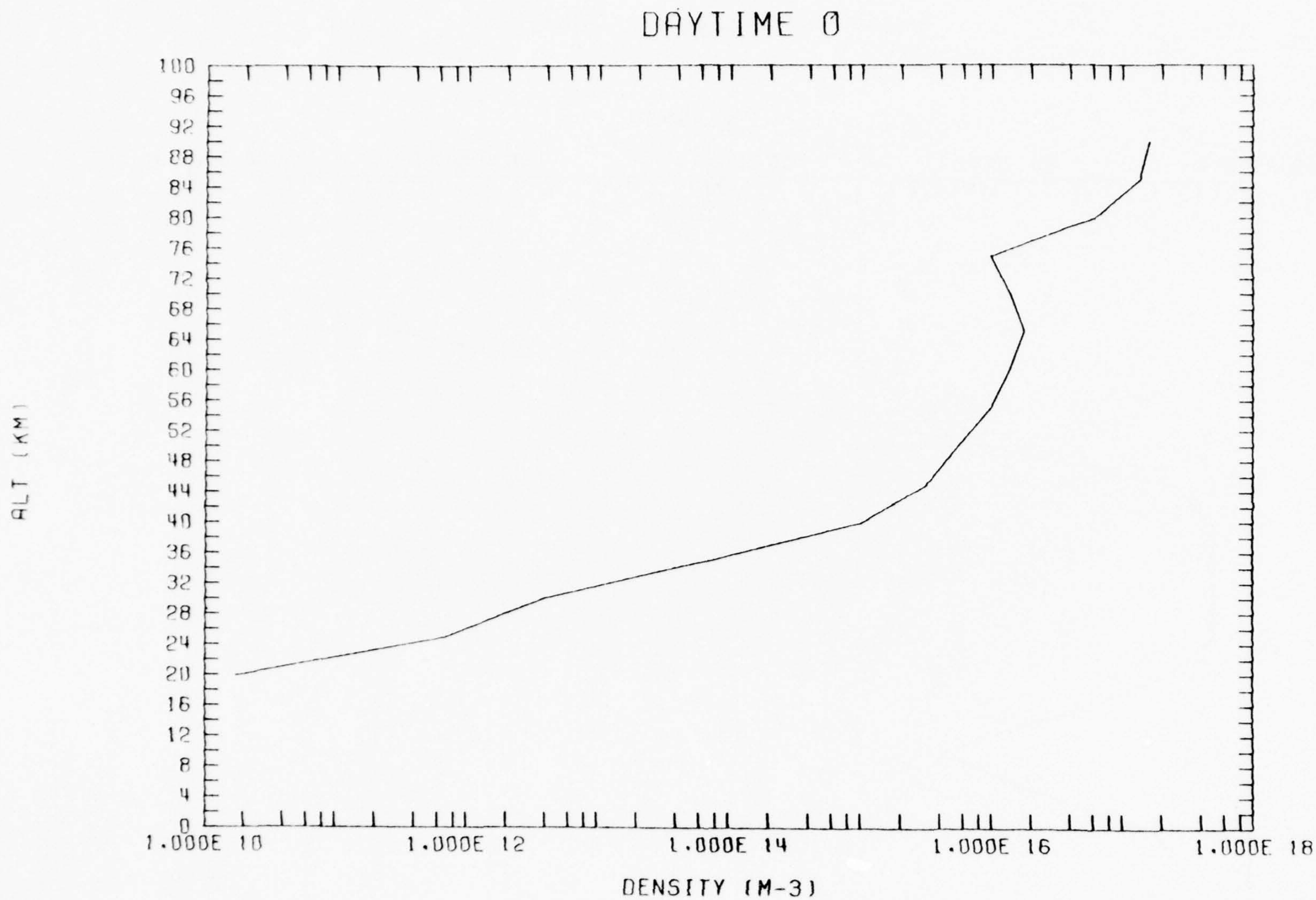

Figure 16. O(^{3}P) daytime profile.

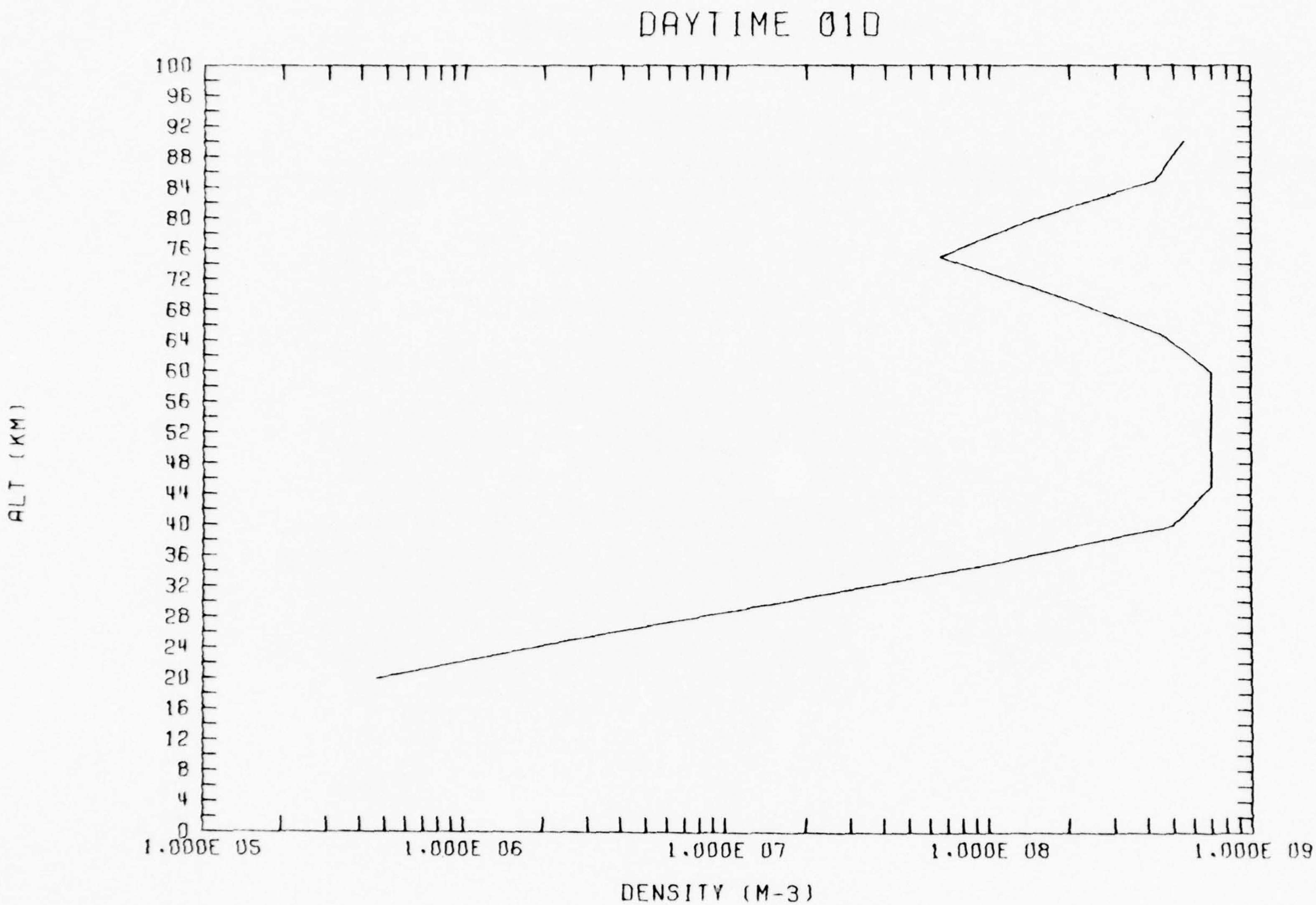

Figure 17. $O(^1D)$ daytime profile.

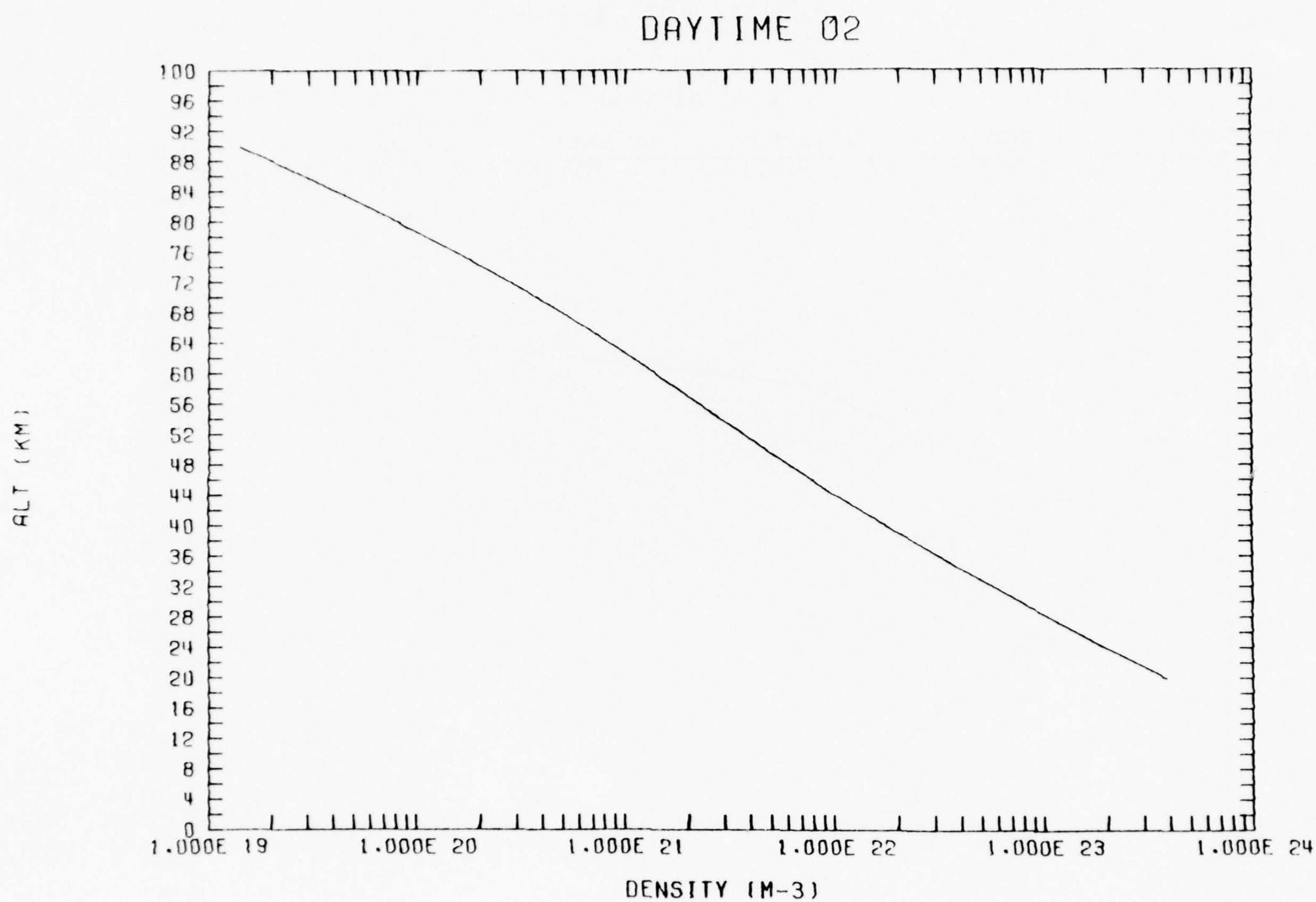

Figure 18. $O_2(^3\Sigma_g^-)$ daytime profile.

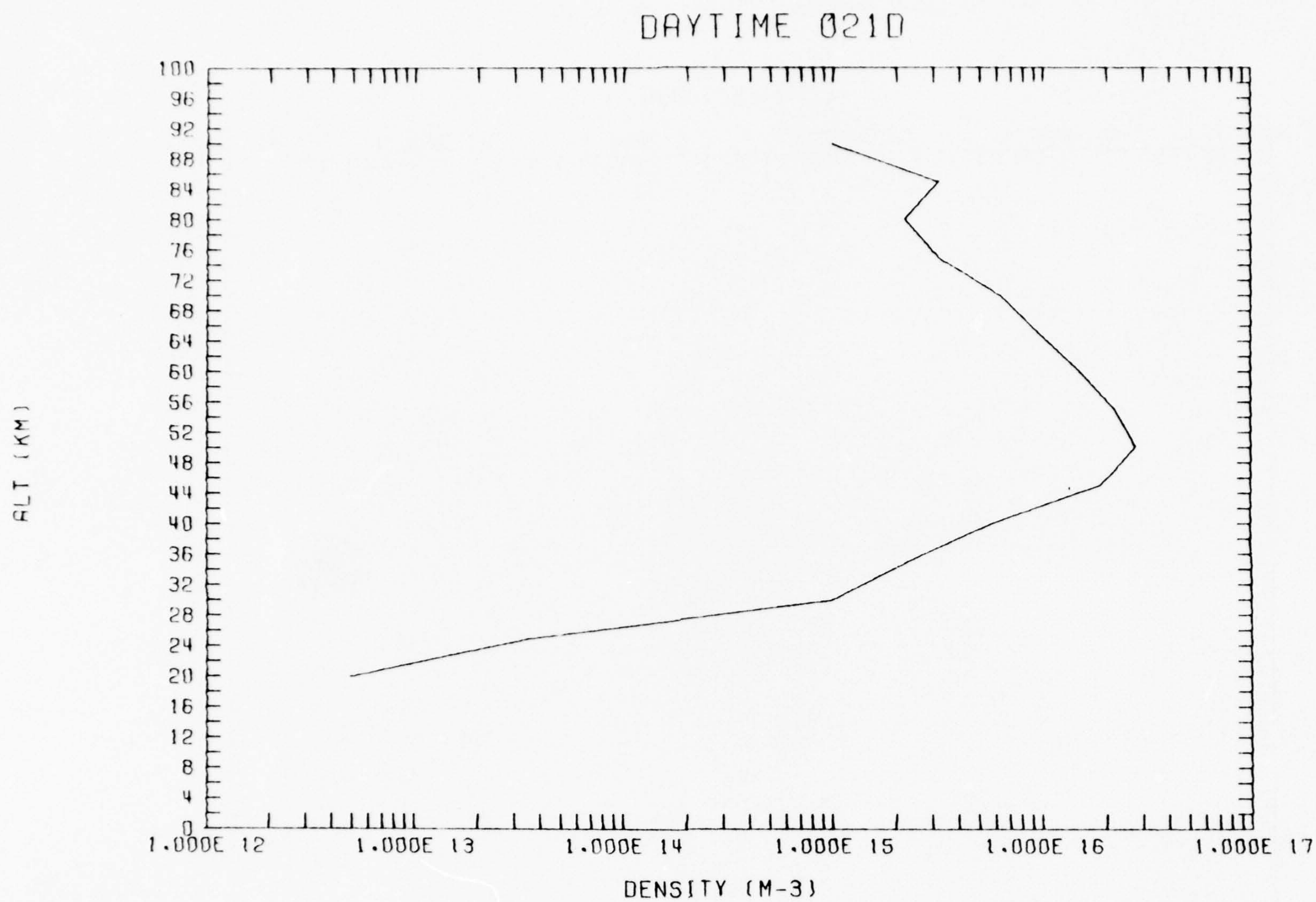

Figure 19. $O_2(^1\Delta_g)$ daytime profile.

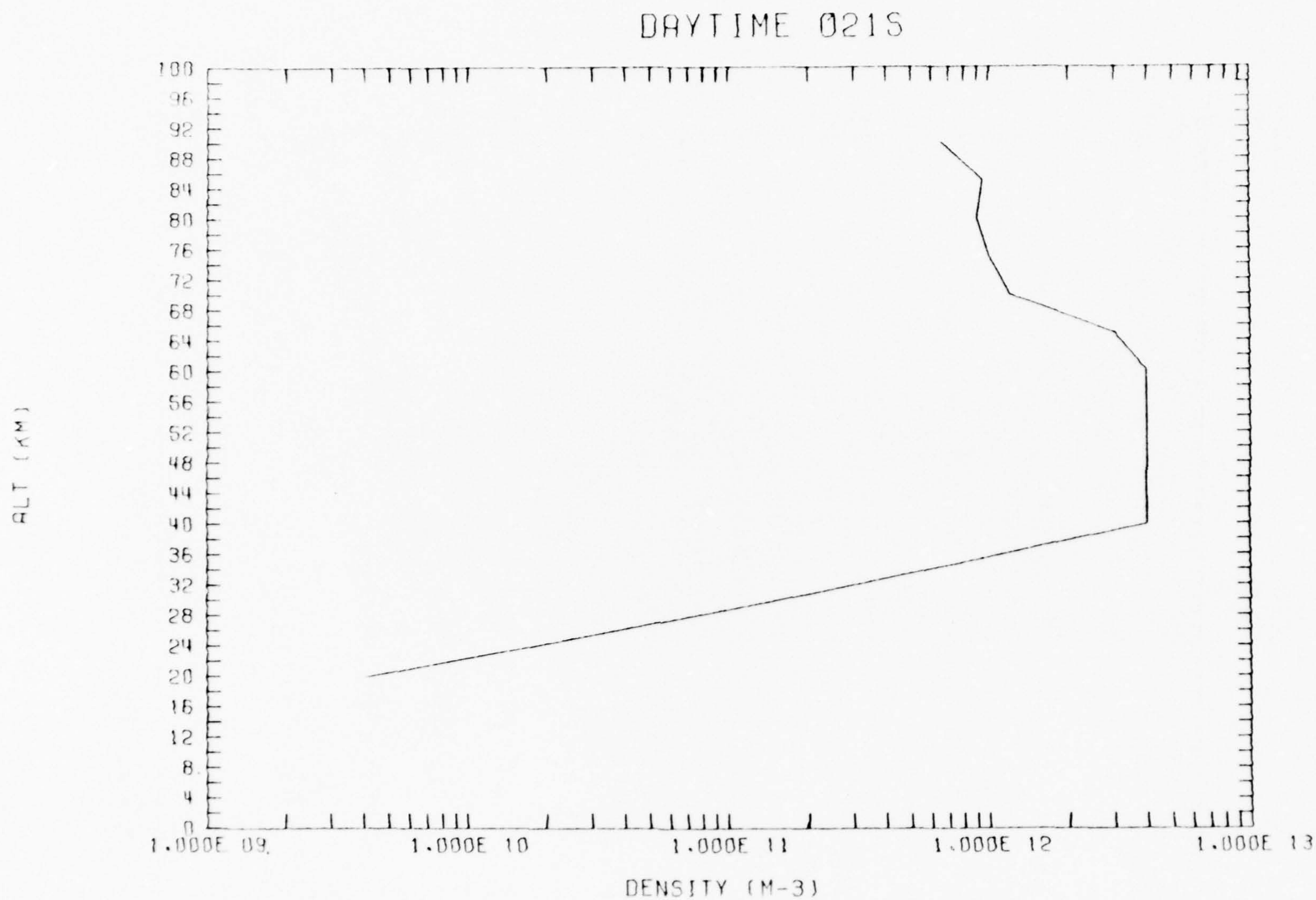

Figure 20. $O_2(^1\Sigma_g^+)$ [illegible] time profile.

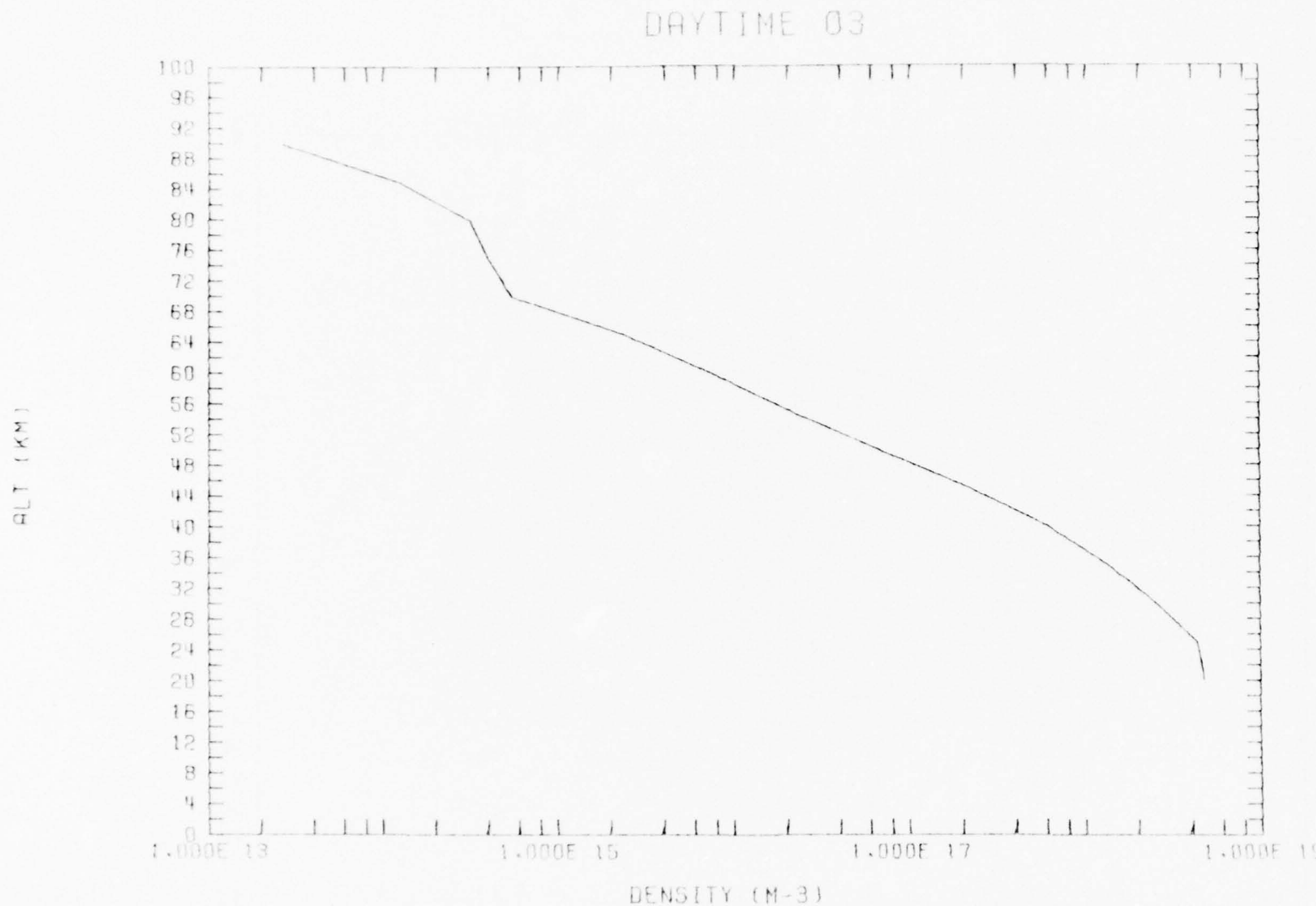

Figure 21. O_3 daytime profile.

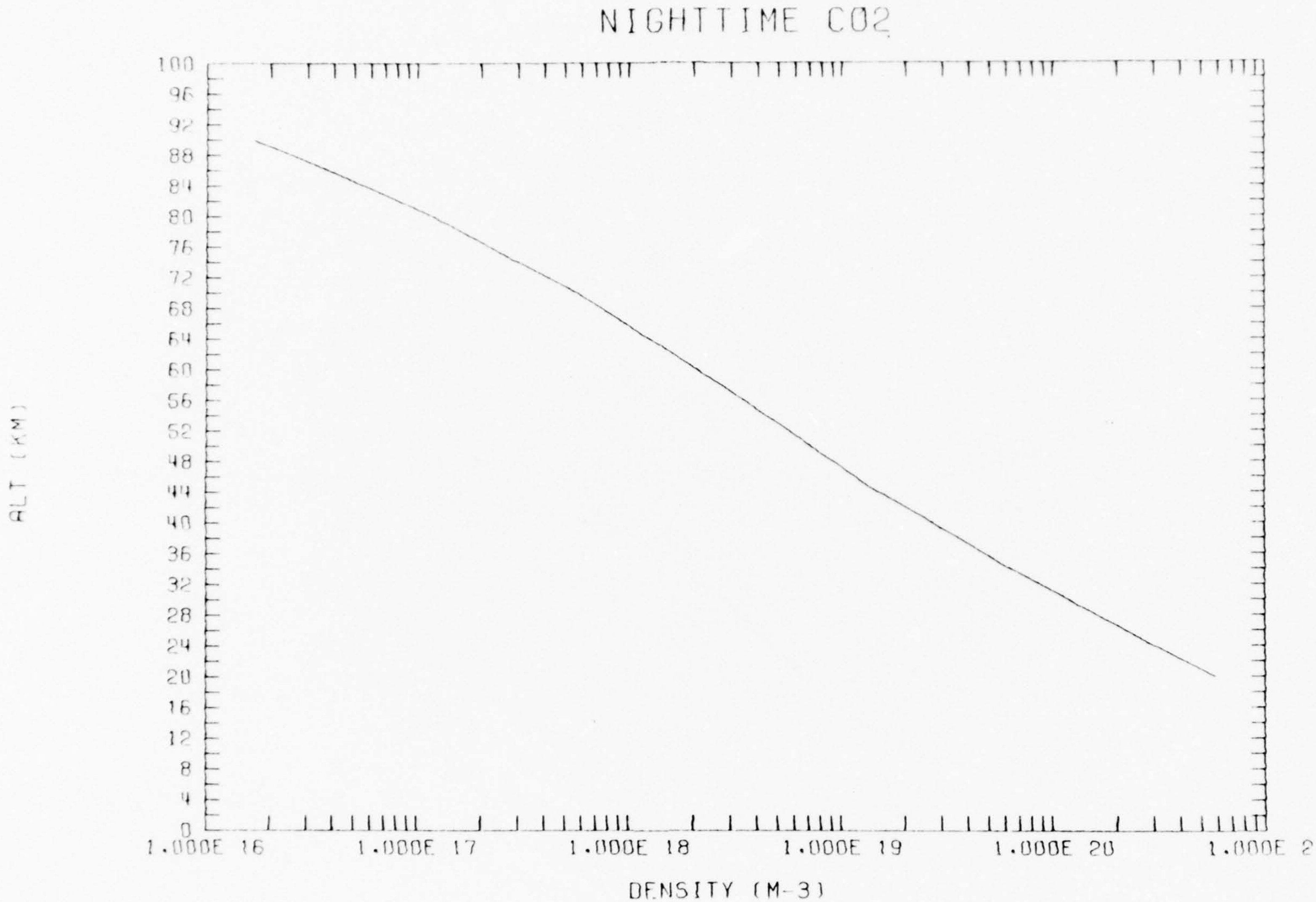

Figure 22. CO_2 nighttime profile.

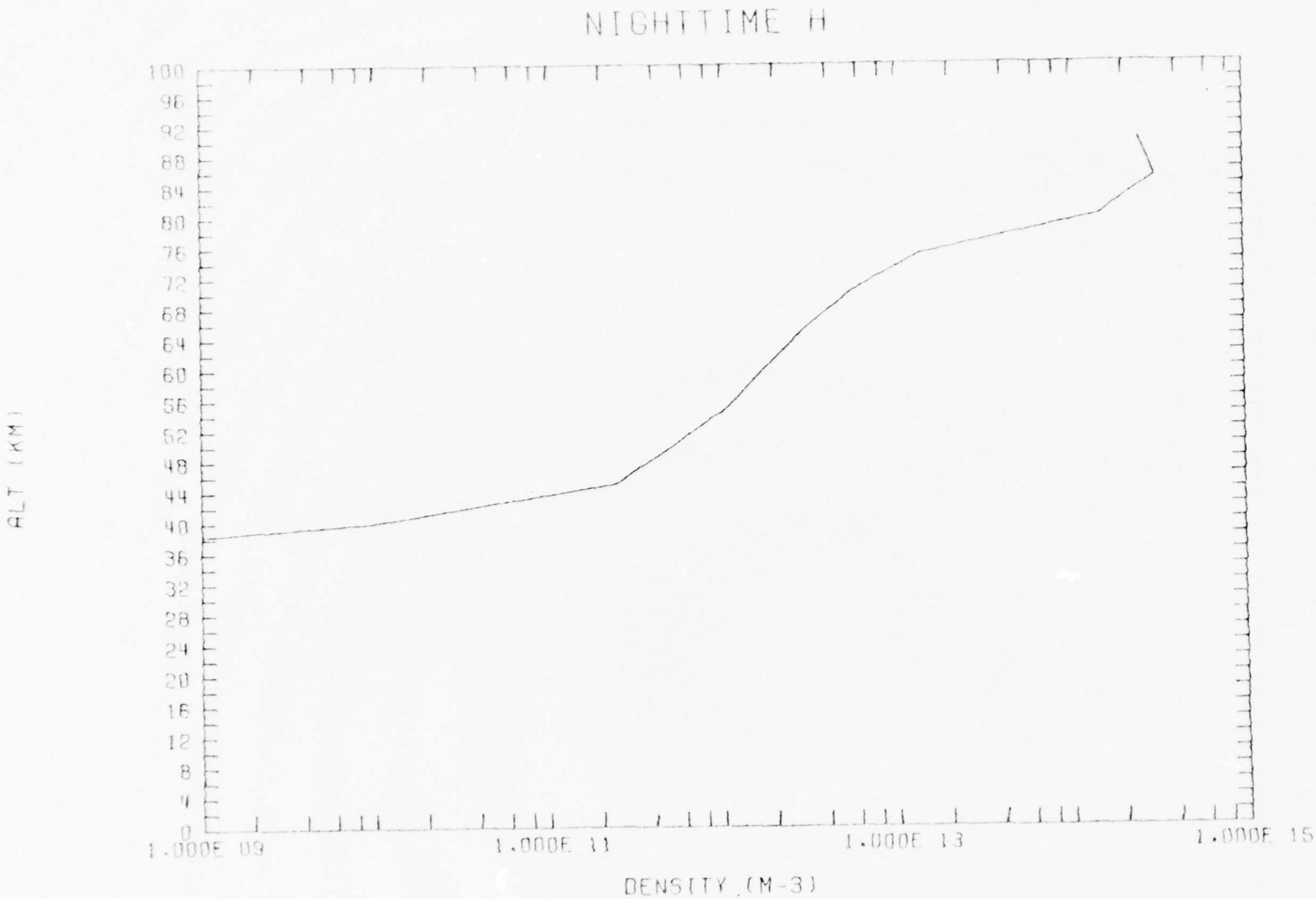

Figure 23. H nighttime profile.

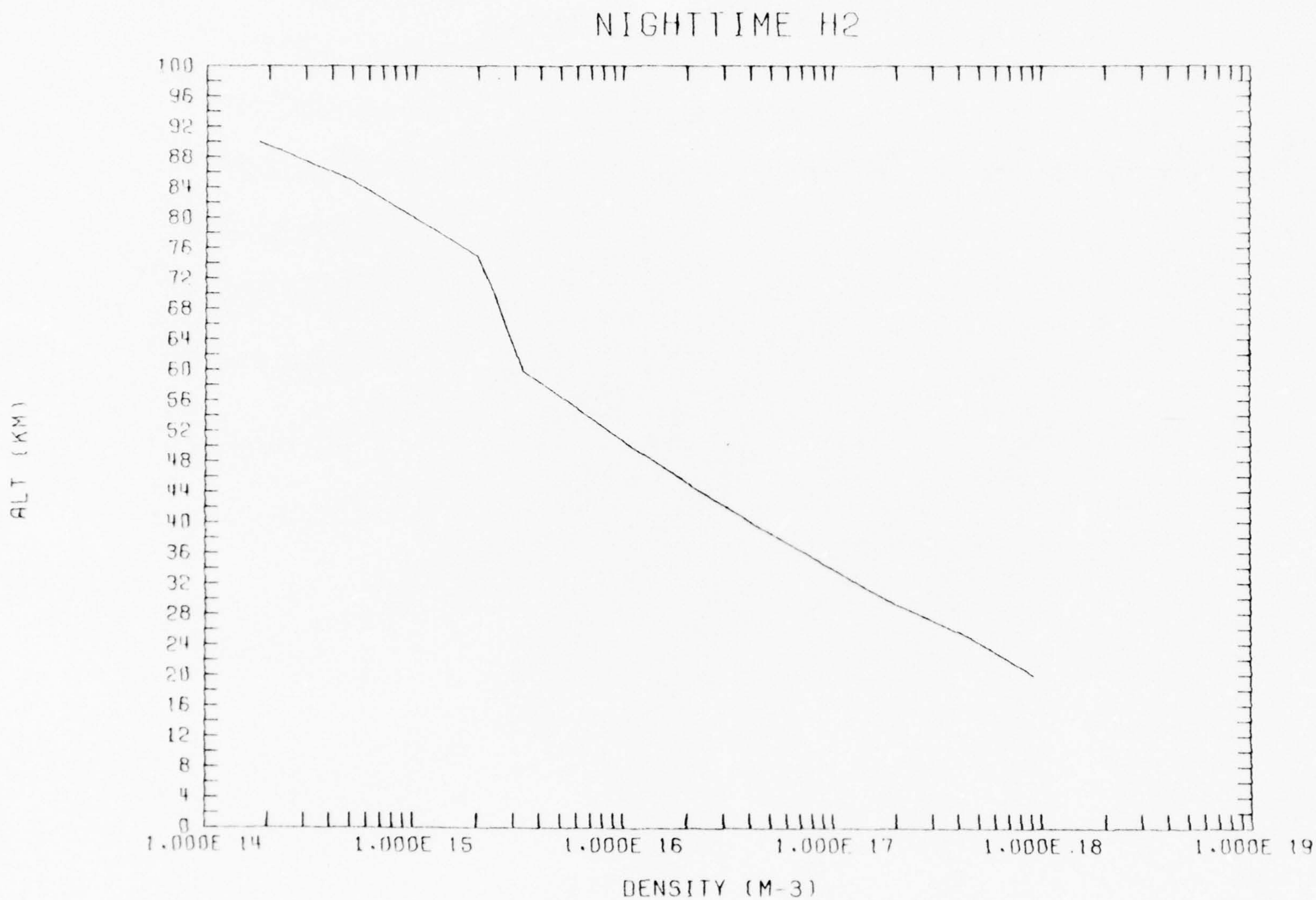

Figure 24. H_2 nighttime profile.

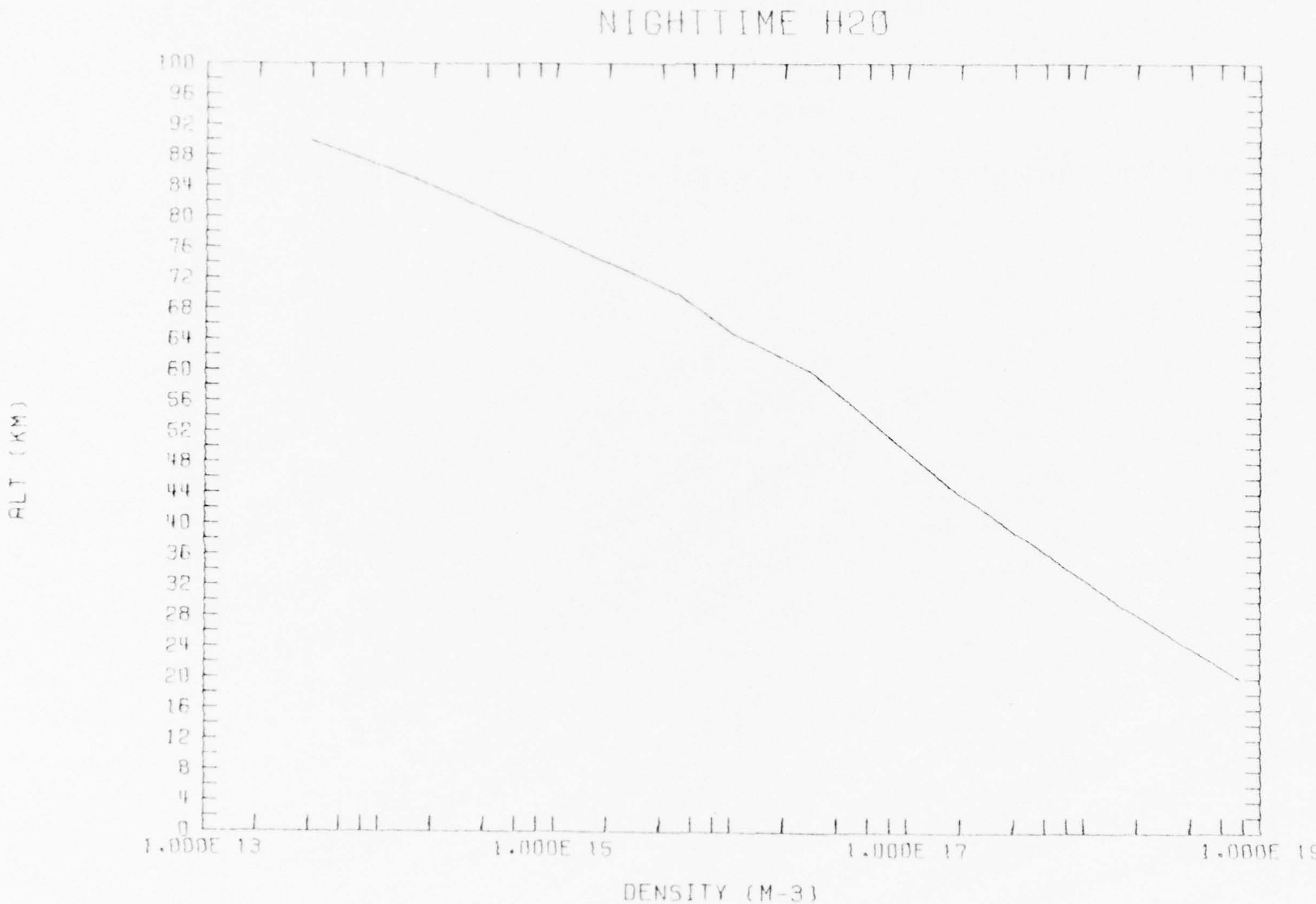

Figure 25. H_2O nighttime profile.

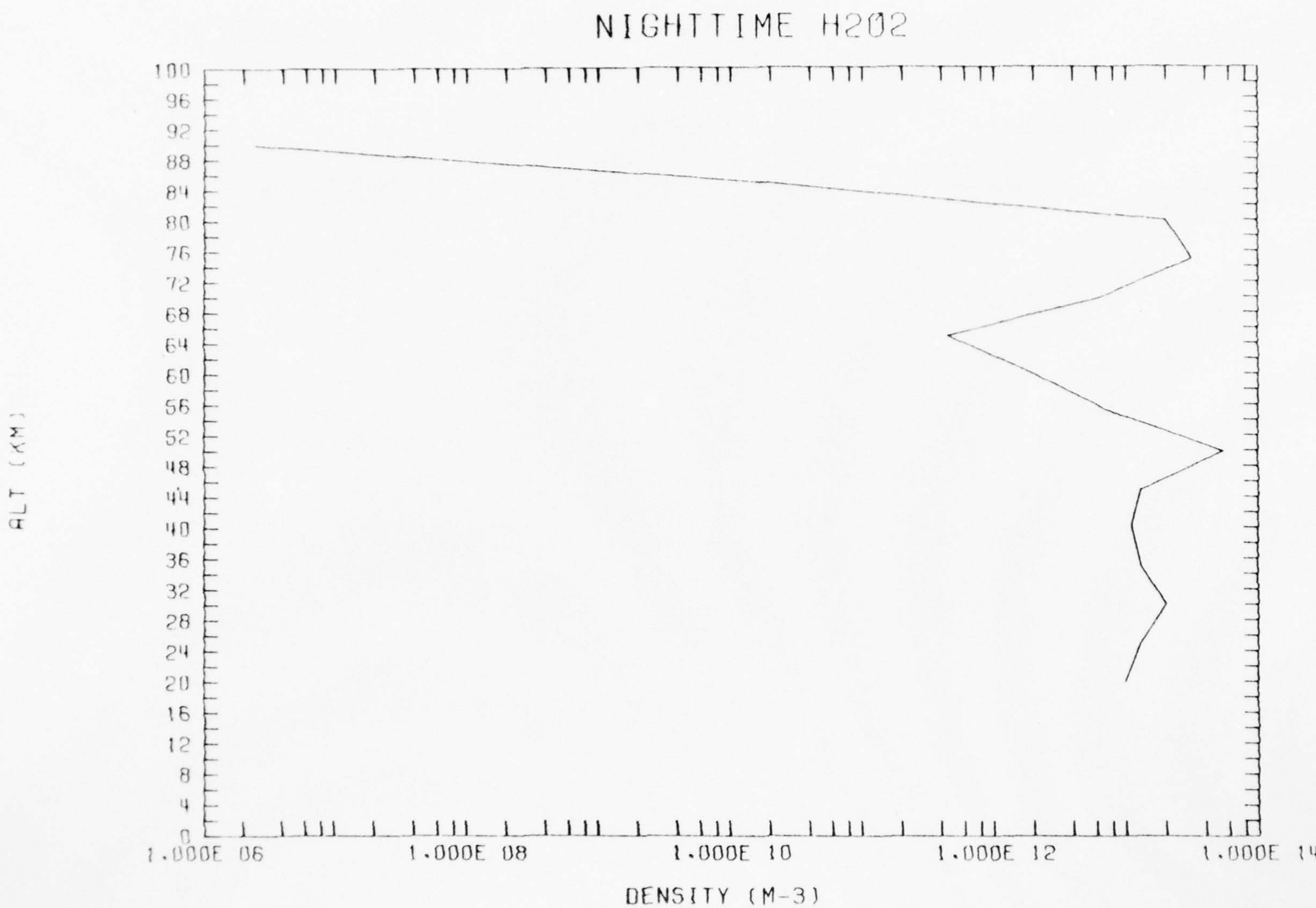

Figure 26. H_2O_2 nighttime profile.

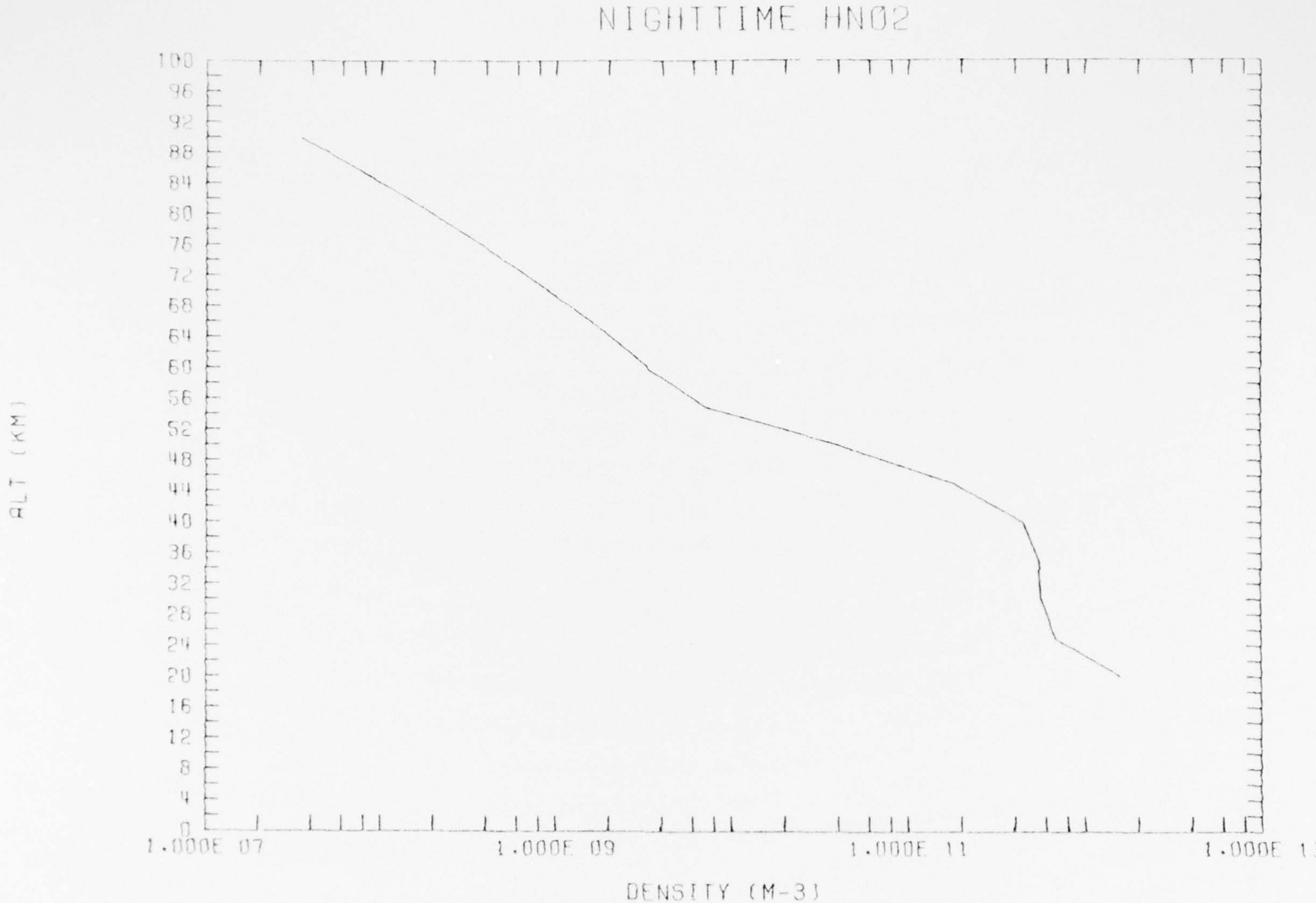

Figure 27. HNO_2 nighttime profile.

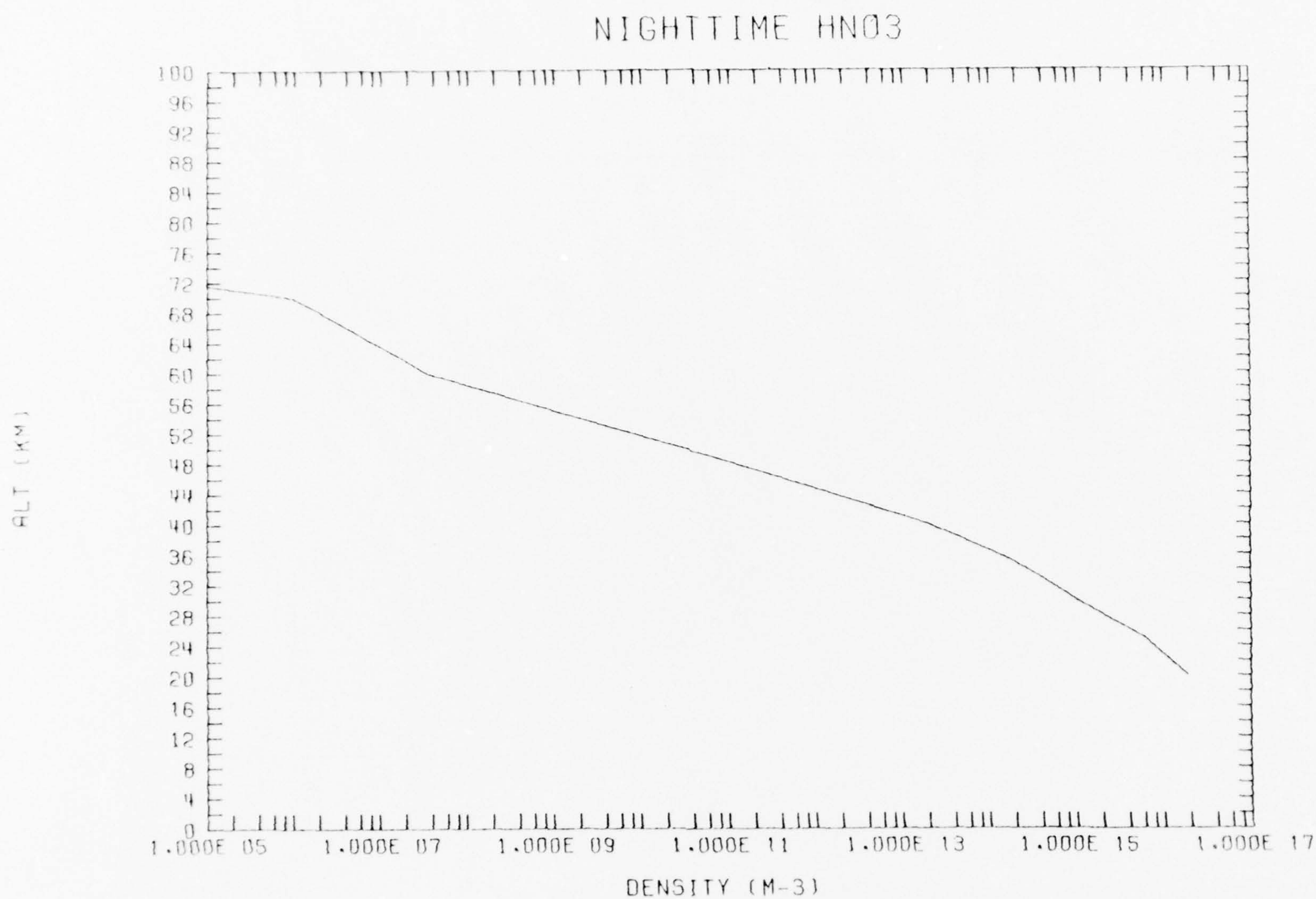

Figure 28. HNO_3 nighttime profile.

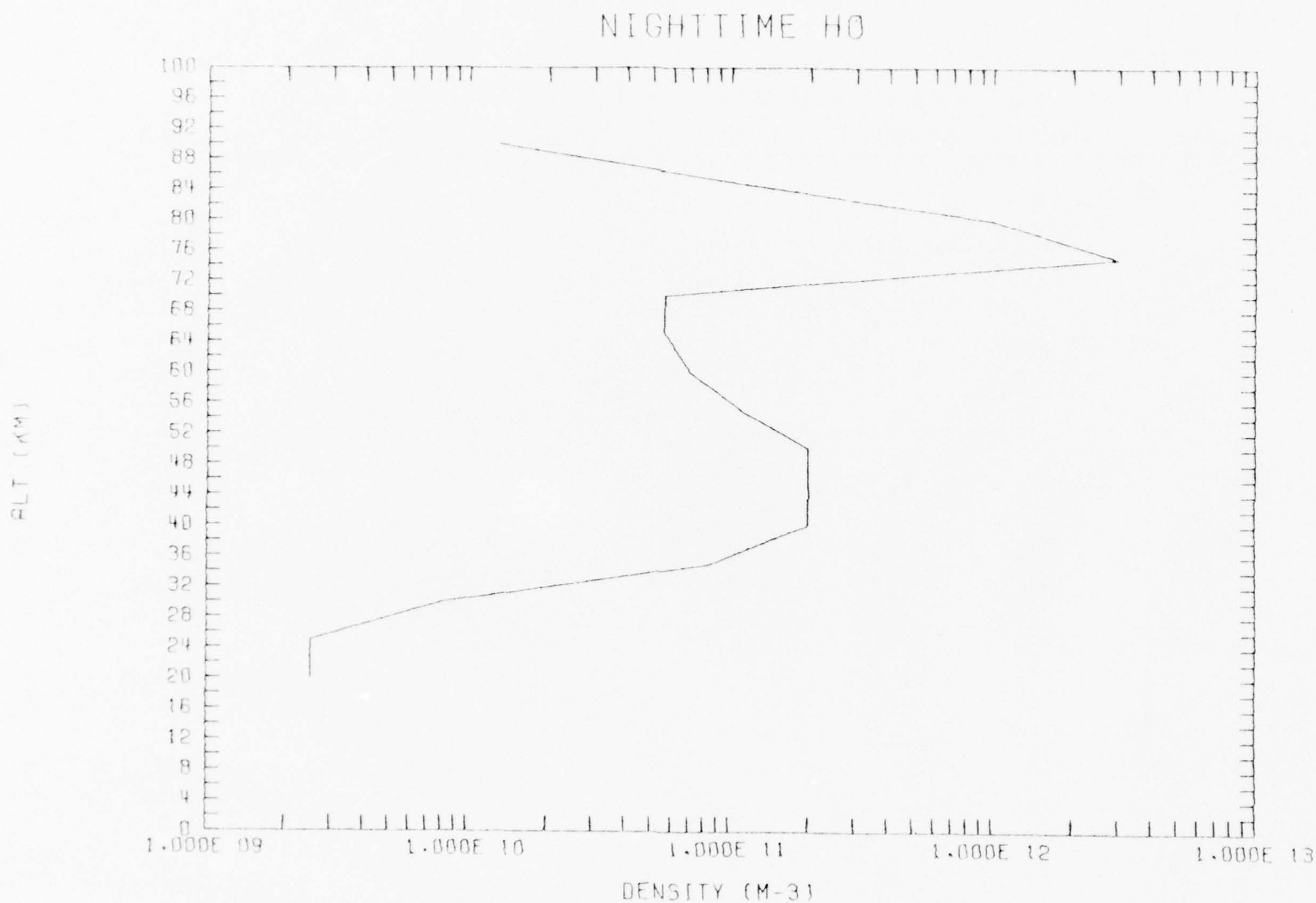

Figure 29. HO nighttime profile.

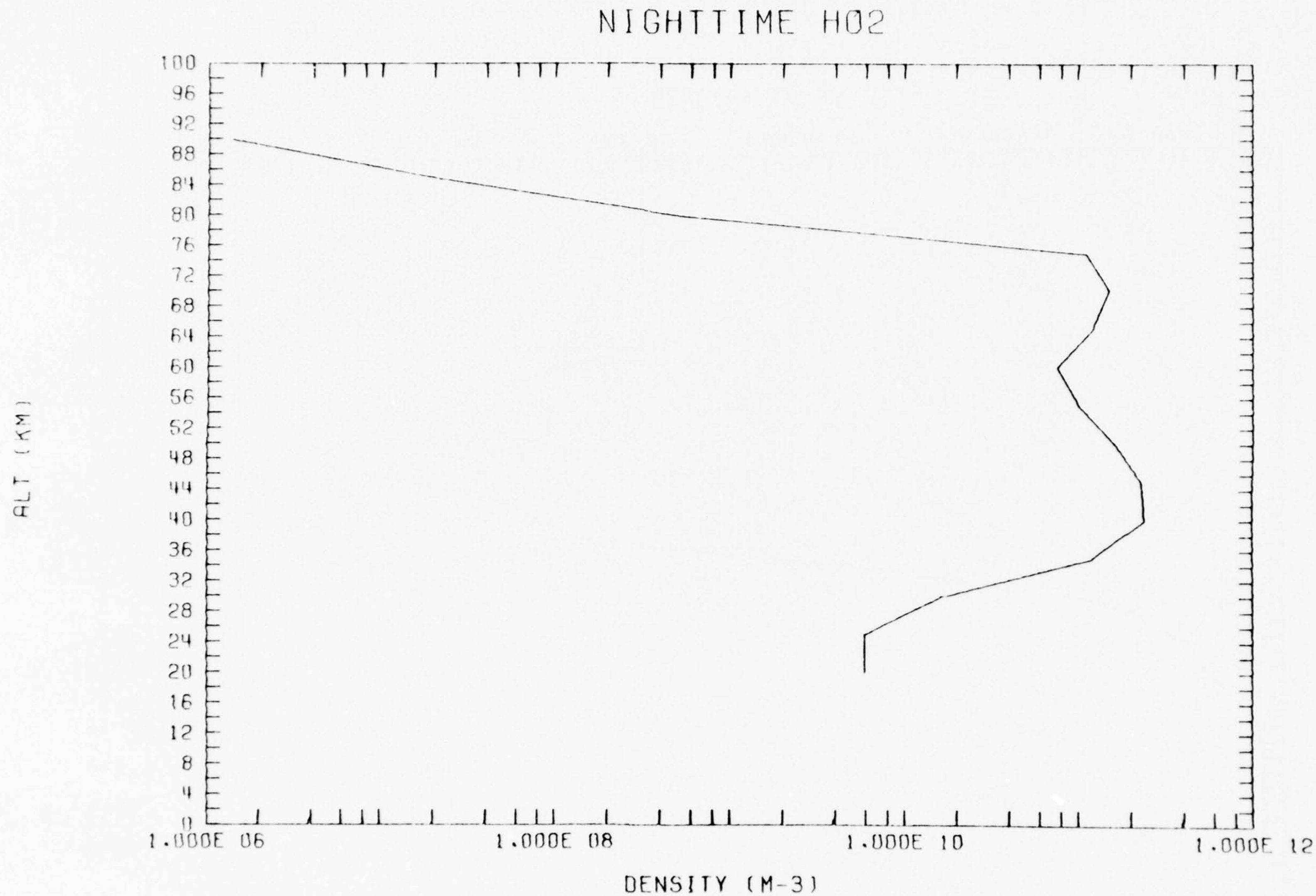

Figure 30. HO_2 nighttime profile.

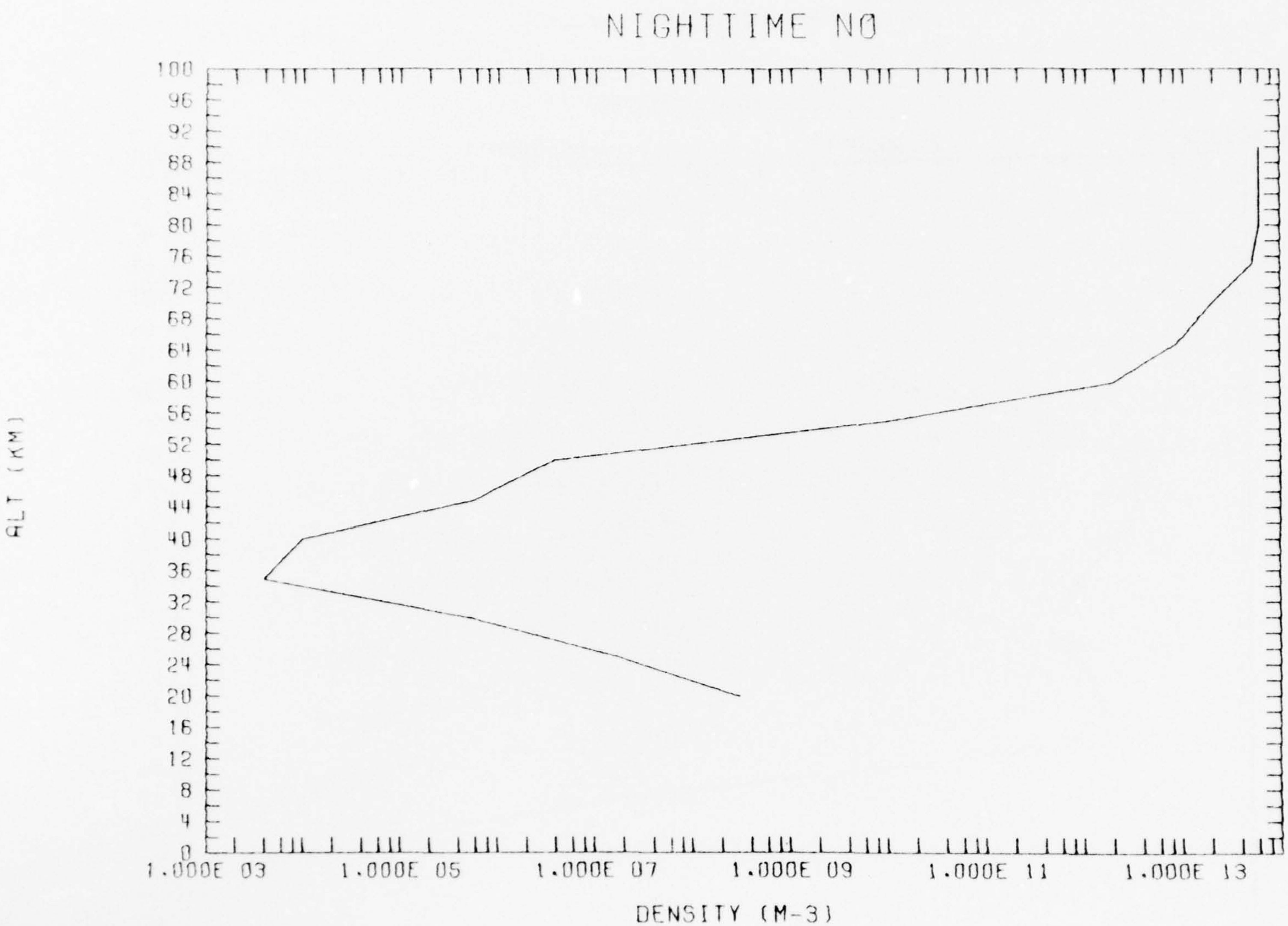

Figure 31. NO nighttime profile.

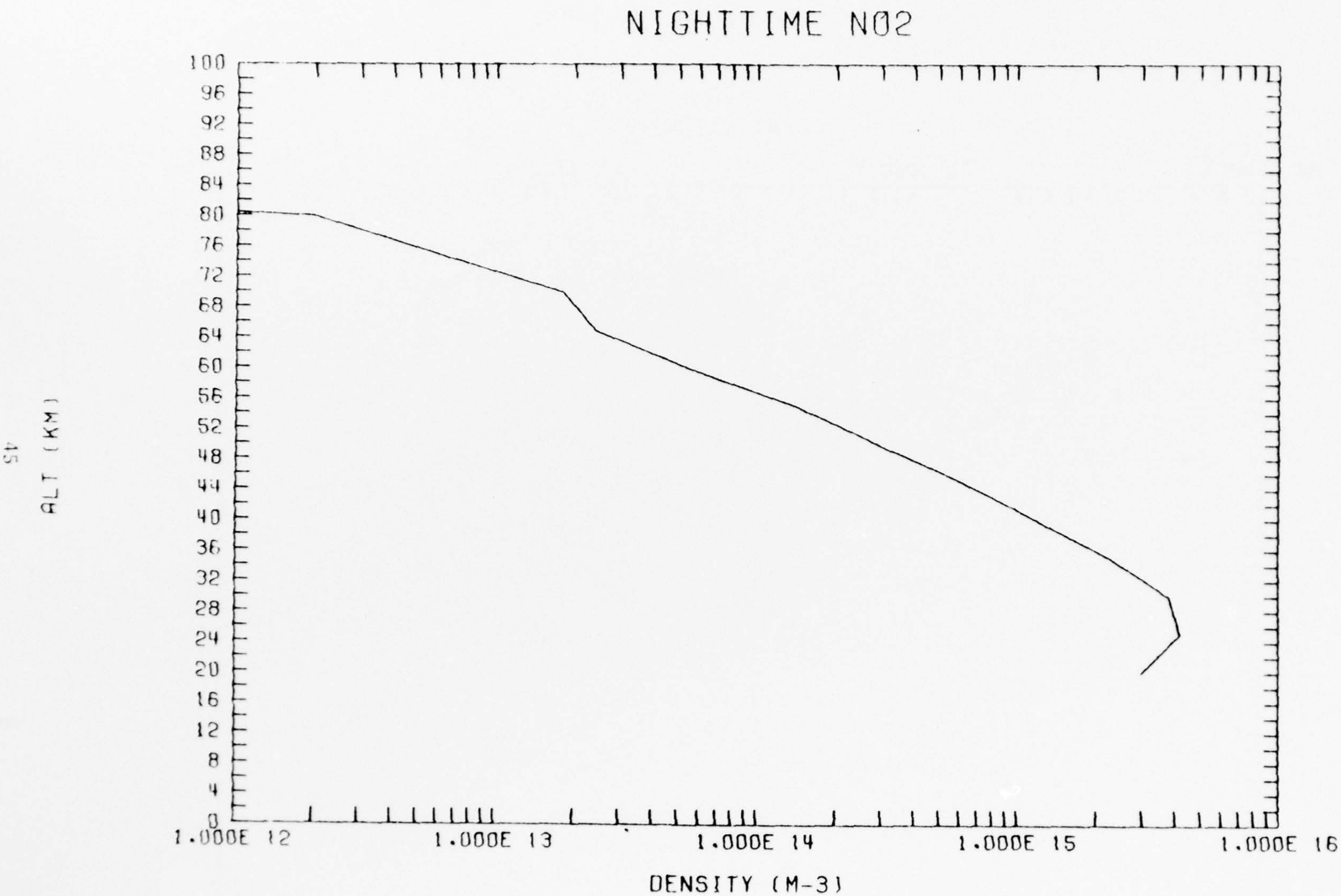

Figure 32. NO_2 nighttime profile.

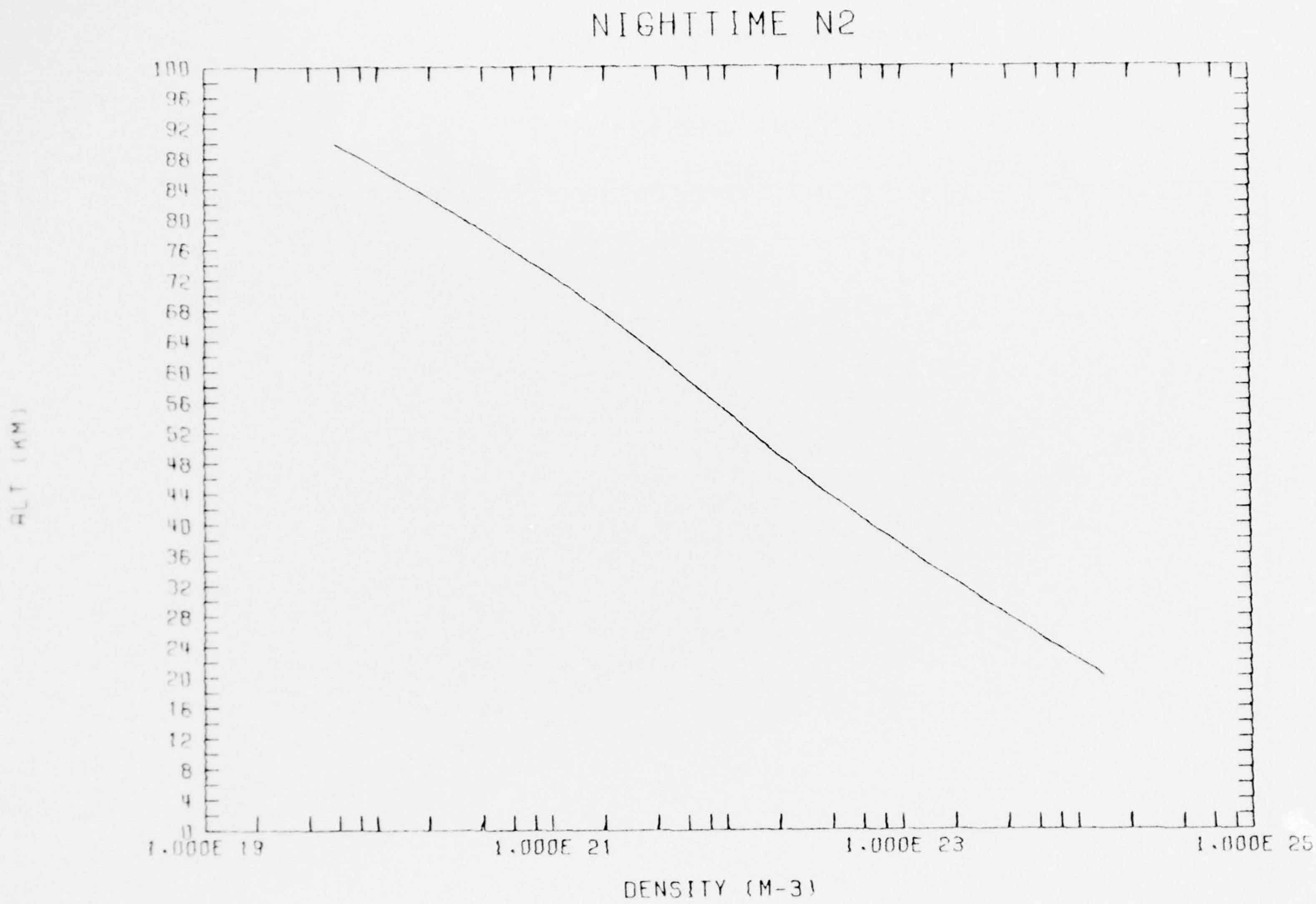

Figure 33. N_2 nighttime profile.

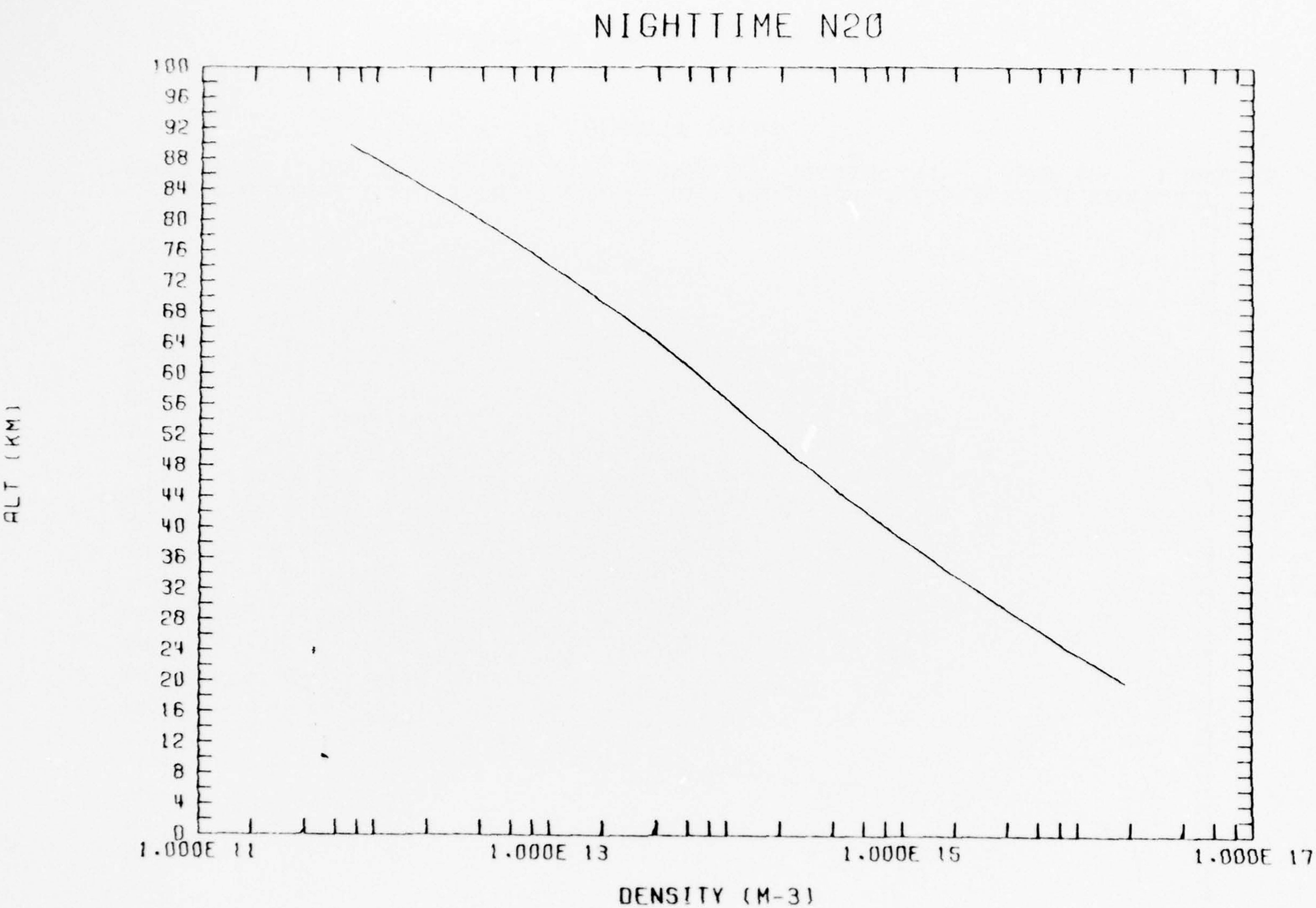

Figure 34. N_2O nighttime profile.

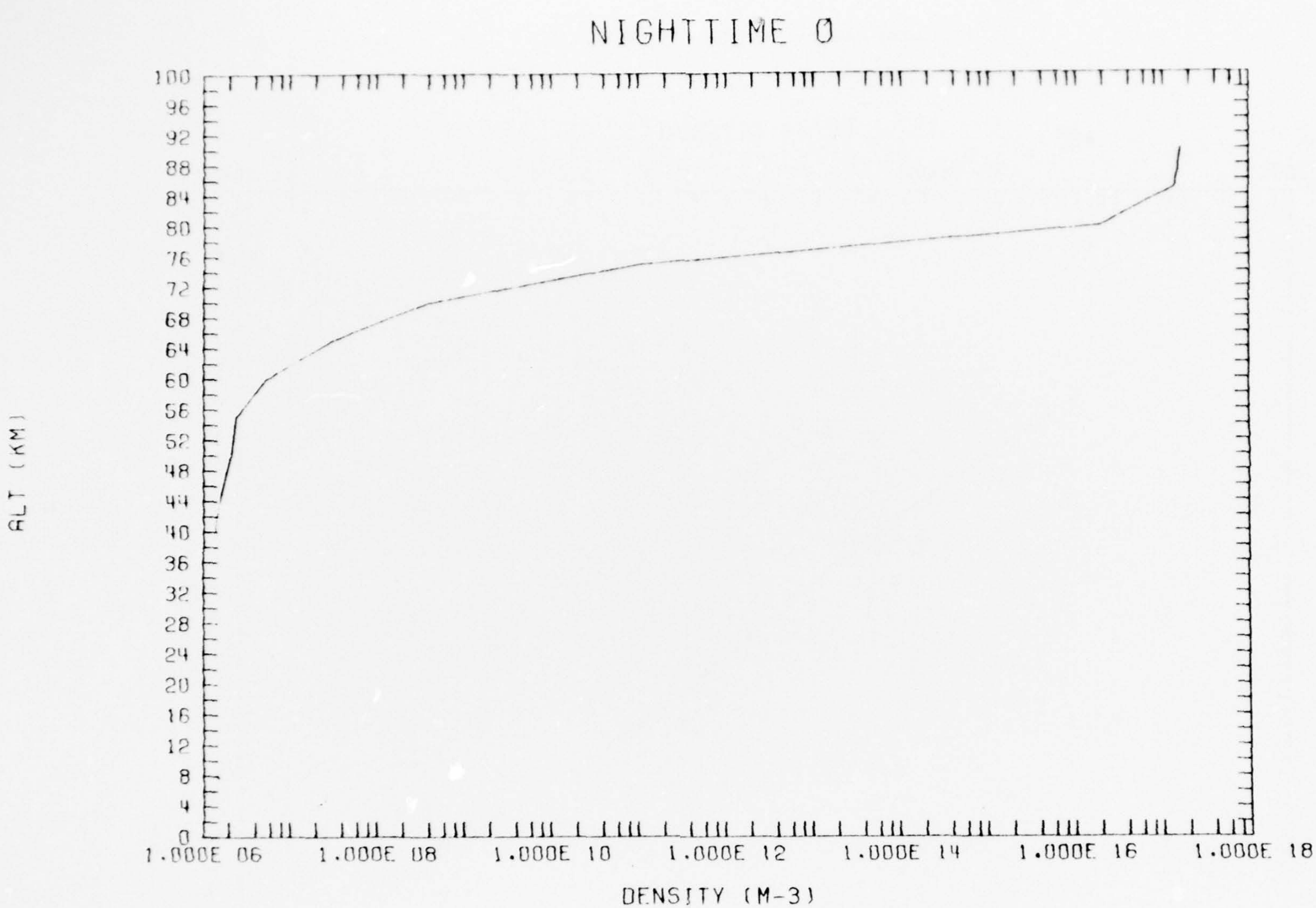

Figure 35. O(^3P) nighttime profile.

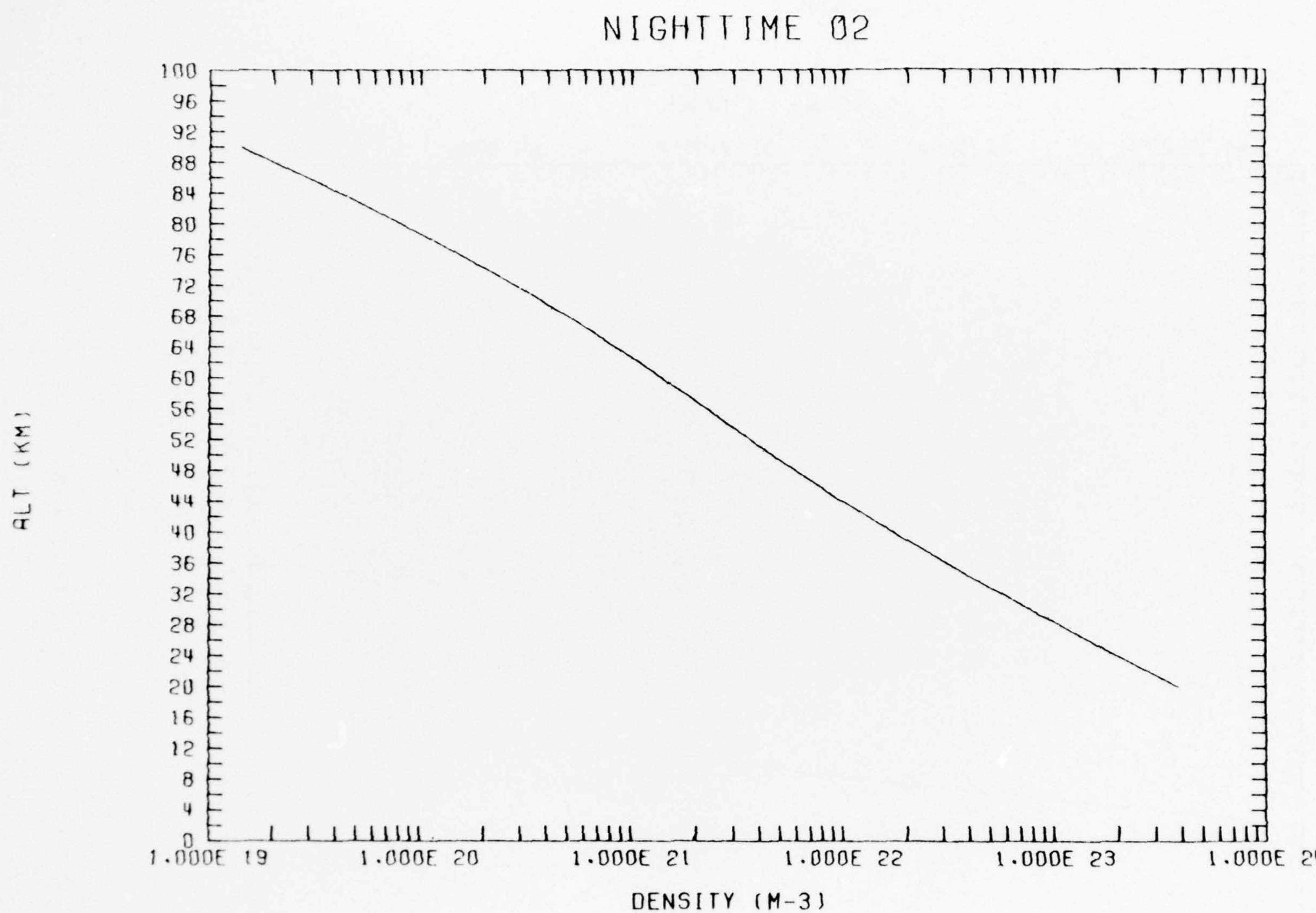

Figure 36. $O_2(^3\Sigma_g^-)$ nighttime profile.

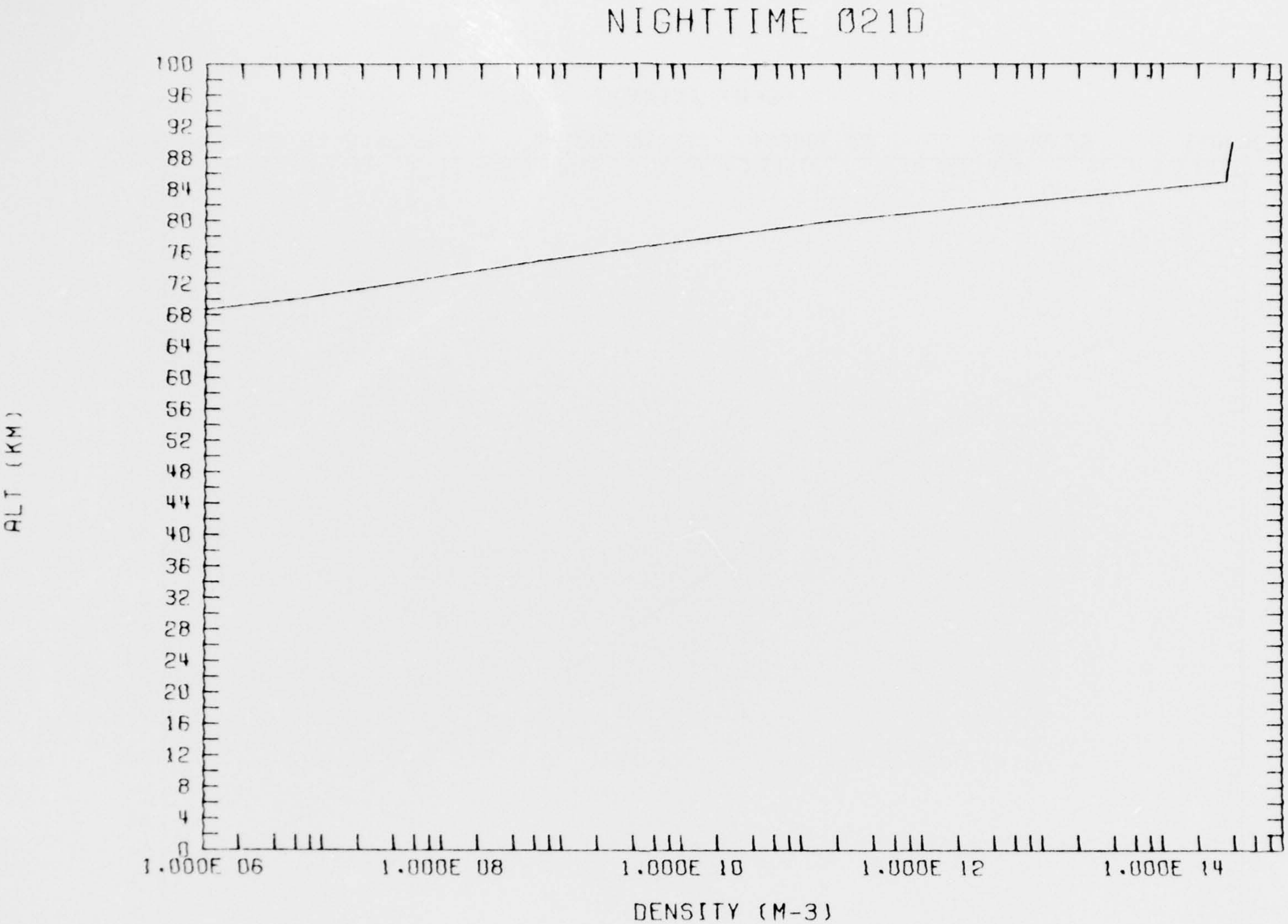

Figure 37. $O_2(^1\Delta_g)$ nighttime profile.

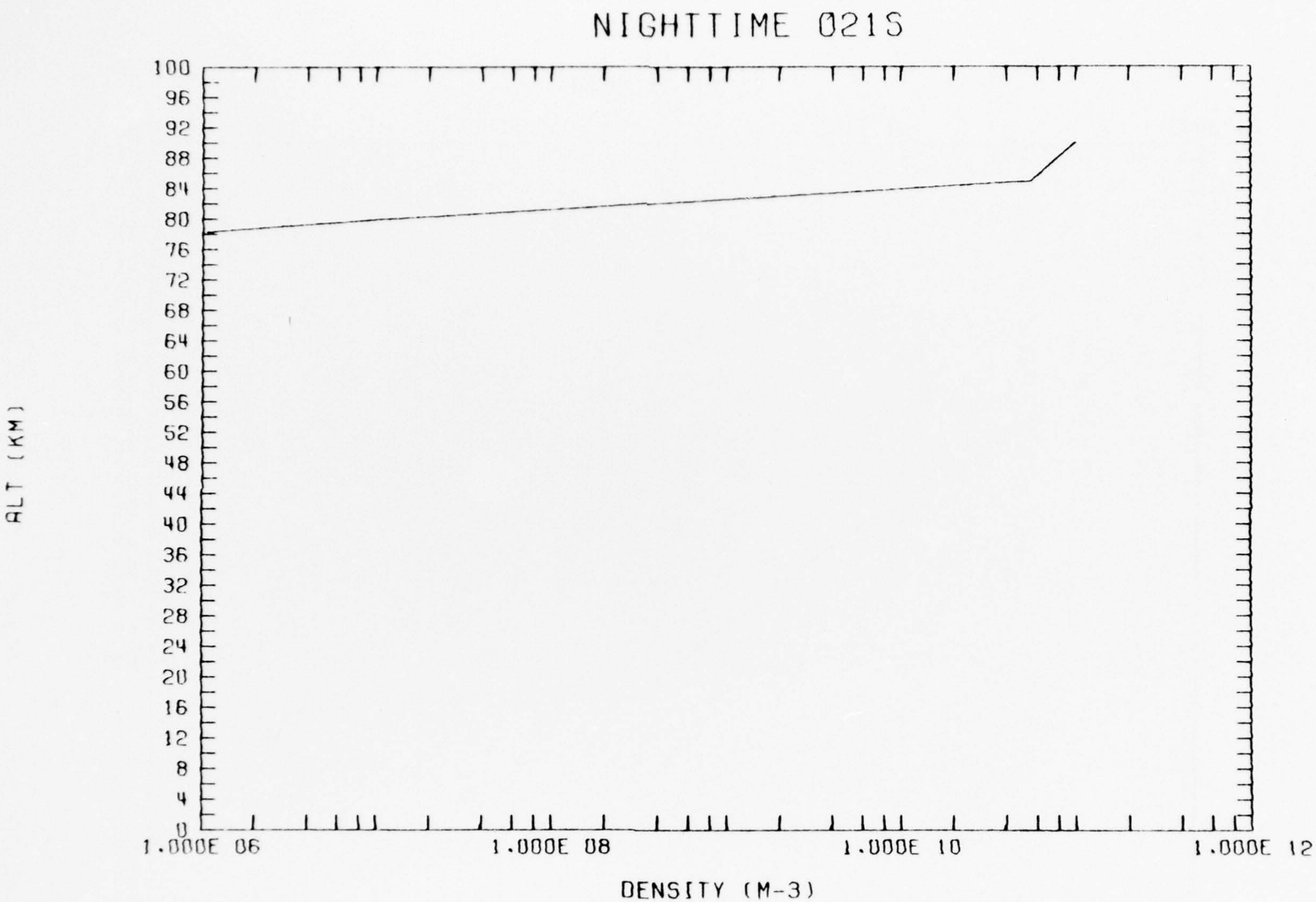

Figure 38. $O_2(^1\Sigma_g^+)$ nighttime profile.

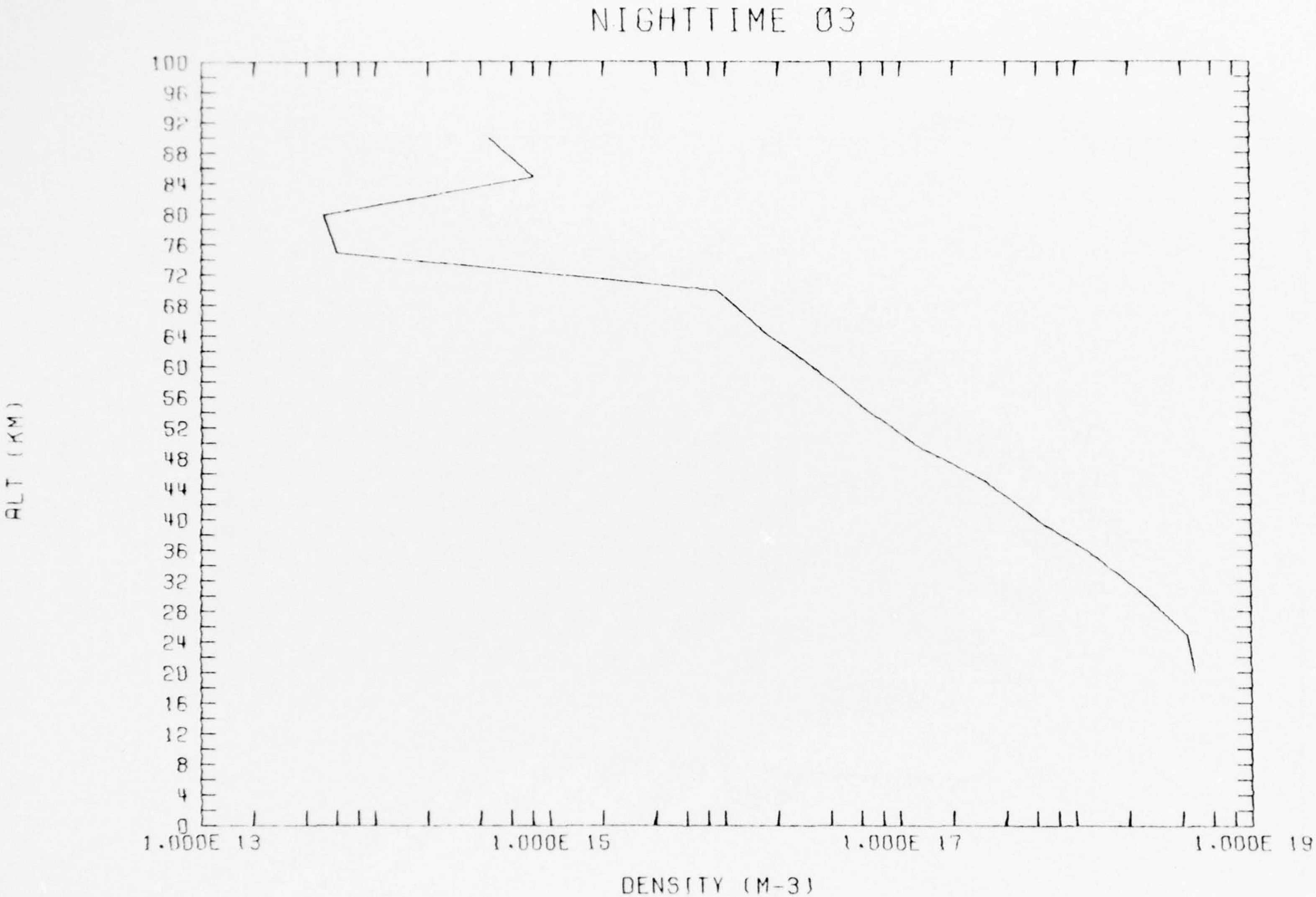

Figure 39. O_3 nighttime profile.

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